

A CATALOG OF ROTARY SCREW TRAPS THAT HAVE BEEN OPERATED IN THE CENTRAL VALLEY OF CALIFORNIA SINCE 1992

Report prepared by the
United States Department of the Interior
Central Valley Project Improvement Act
U.S. Fish and Wildlife Service
Comprehensive Assessment and Monitoring Program
Sacramento, California

2010



The photographs on the front cover consist of a single rotary screw trap deployed on Clear Creek in Shasta County, California and two rotary screw traps deployed on the American River in Sacramento County, California.

This document has been formatted to be printed on both sides of a sheet of paper.

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Acknowledgements

This report would not have been possible without the substantial effort expended by all of the biologists who have operated rotary screw traps across the Central Valley since 1992. Their commitment to collecting data that can be used to understand trends in life history, abundance, and production of Chinook salmon deserves special recognition, particularly on those days when outdoor weather conditions make an office seem like a hospitable place.

Special recognition is due to those individuals who reviewed and provided comment on draft copies of the data summaries contained within this report. These individuals are: Colleen Harvey Arrison, Robyn Bilski, Bill Poytress, Diane Coulon, Andrea Fuller, Jason Kindopp, Duane Massa, Tracy McReynolds, Chrissy Sonke, Robert Vincik, Dave Vogel, Clark Watry, and Kellie Whitton.

Introduction

The Comprehensive Assessment and Monitoring Program (CAMP) was established pursuant to the Central Valley Project Improvement Act of 1992. One of that program's goals can be summarized as follows:

Assess the relative effectiveness of different categories of restoration actions that are designed to increase the production number of naturally-produced (i.e., wild) Chinook salmon (*Oncorhynchus tshawytscha*) in the Central Valley of California. These categories include managing water regimes to create beneficial effects for salmon, modifying or eliminating structures inhibiting salmon passage, conducting habitat restoration activities that create or restore suitable habitat for adult or juvenile salmon, and installing fish screens that eliminate or reduce salmon mortality.

The 1997 CAMP Implementation Plan provides a generalized process for assessing the effects of different categories of restoration actions, and it suggests that changes in the abundance of juvenile salmon will provide greater insight into the effects of restoration actions than changes in the abundance of adult salmon. The emphasis on juvenile salmon exists because the freshwater environment integrates the different factors that directly affect juvenile salmon, including restoration actions, and minimizes some of the confounding factors that influence the abundance of adult salmon, e.g., environmental conditions in the Pacific Ocean.

In the Central Valley of California, the rotary screw trap (RST) is the tool that is commonly used to assess changes in the abundance or production of juvenile Chinook salmon. Unfortunately, no single reference currently exists that describes where RSTs have been deployed in the Central Valley, and or how these tools have been used to monitor juvenile salmon. This document attempts to fill that void by identifying and describing RST operations that have occurred at 27 locations in the Central Valley. For each of those locations, this document: (1) provides basic site information, (2) describes the sampling gear used, (3) provides a general description of data collection techniques, (4) describes the trap efficiency tests done at some locations, and (5) describes the methods used to process data. By consolidating this information in a single document, it is also possible to facilitate side-by-side comparisons of the different RSTs to better understand their similarities and differences.

In the future, staff with the CAMP will work with the biologists that operate RSTs at key locations in the Central Valley in an effort to standardize data collection, analysis, and storage routines to the extent that is possible. The CAMP places a premium on that effort because the integration of standardized data sets that document changes in the abundance or production of juvenile salmon from a variety of locations and environmental settings offers an enhanced ability to understand the mechanisms that govern juvenile salmon numbers, and whether the restoration activities in a given watersheds are leading to measurable changes in the numbers of juvenile salmon.

Methods

The information that is used to characterize the RST operations described in this report was derived from 144 annual RST reports that were developed by biologists who conducted trapping activities in the Central Valley. Those 144 RST reports are available on the CAMP's website under the "Central Valley Rotary Screw Trap Reports" tab at

http://www.fws.gov/sacramento/CAMP/camp_documents_and_projects.htm.

To characterize the RST operations, CAMP staff conducted the following activities:

1. Reviewed pertinent sections in the 144 annual RST reports that describe the methods used to collect juvenile salmonid data;
2. Developed a database structure that could be used to describe five categories of information that include: (1) basic site information, (2) sampling gear used, (3) a general description of data collection techniques, (4) the trap efficiency tests done at some locations, and (5) methods used to process data. Metadata describing the fields in these five categories is contained in Appendix A of this report;
3. Populated the database with information pertaining to the five categories of information, based on information in the 144 annual RST reports;
4. Developed draft summaries for each trapping location, and asking the biologists who are currently responsible for collecting RST data at different trapping locations to provide review comments on their respective draft summaries;
5. Revised the database to reflect each biologist's respective comments. The database contents for the following locations were not revised to reflect biologist's comments because no biologist is currently responsible for operating a trap at that location or comments for a location were not provided to the CAMP: (a) lower and upper Clear Creek, (b) Cosumnes River, (c) Hagaman State Park on the Merced River, (d) Balls Ferry on the Sacramento River mainstem, and (e) Shiloh Bridge on the Tuolumne River; and
6. Exported the contents of the database and producing a Microsoft Word with data summaries for each trapping location.

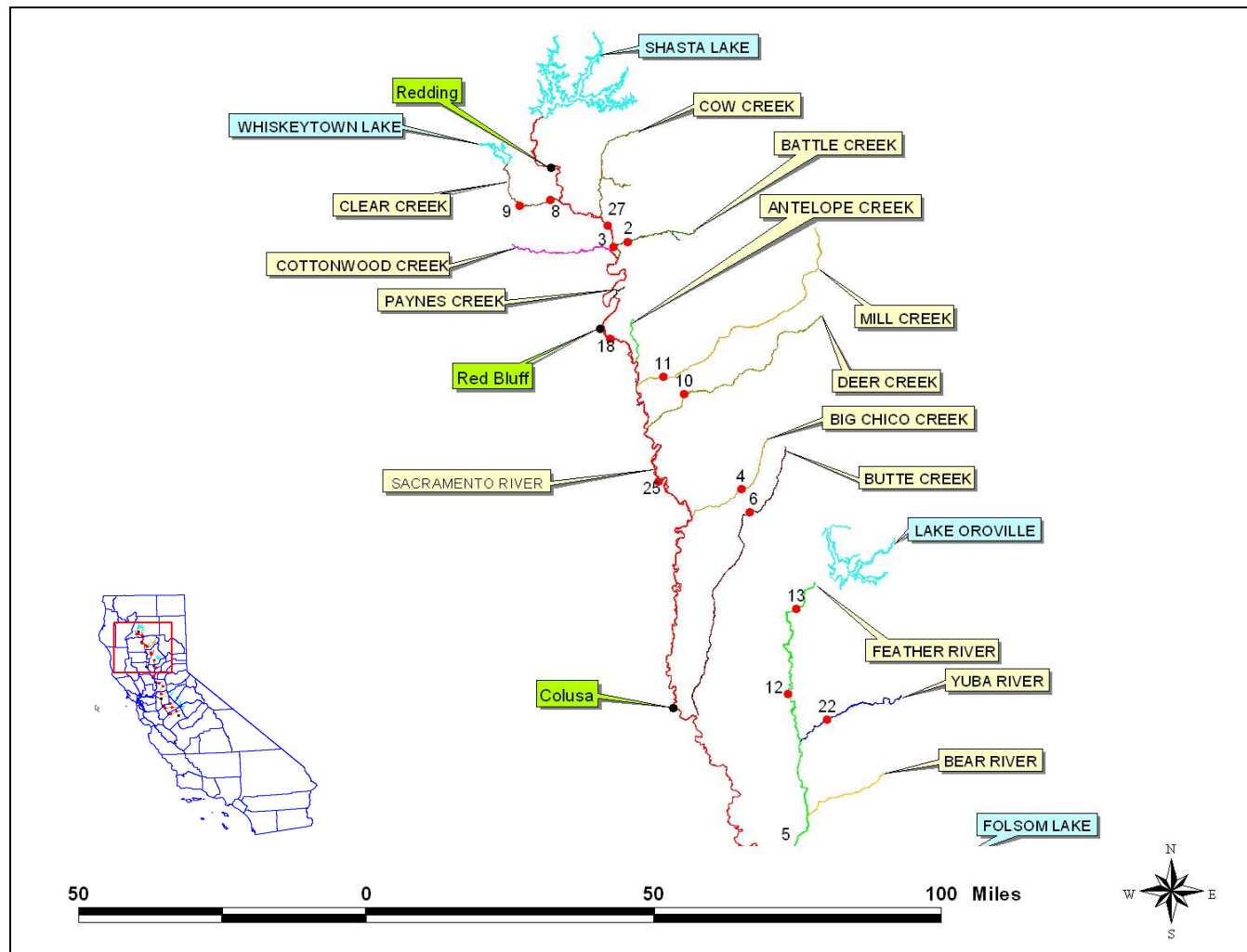
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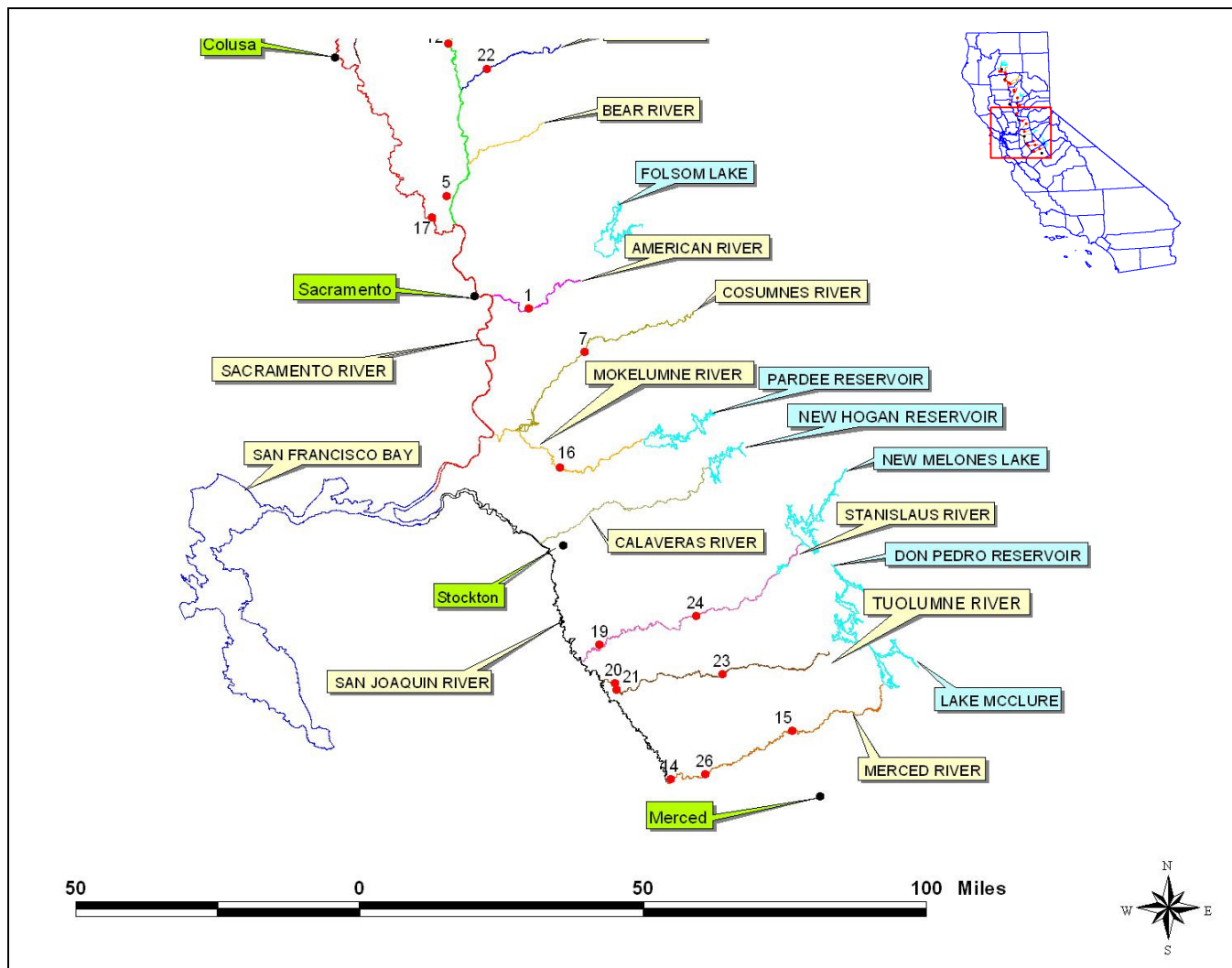
CAMP codes for rotary screw traps in the Central Valley

CAMP RST number	Watershed	Trap location
1	American River	Watt Avenue
3	Battle Creek	Battle Creek - Lower Trap
2	Battle Creek	Battle Creek - Upper Trap
4	Big Chico Creek	Bidwell Park Municipal Golf Course
5	Butte Creek	Maddock Road
6	Butte Creek	Parrott - Phalen Diversion Dam
8	Clear Creek	Clear Creek - Lower Trap
9	Clear Creek	Clear Creek - Upper Trap
7	Cosumnes River	Folsom South Canal Crossing
10	Deer Creek	Deer Creek near Sacramento River confluence
12	Feather River	High Flow Channel - Sunset Pumps
13	Feather River	Low Flow Channel - Steep Riffle
26	Merced River	Hagaman State Park
14	Merced River	Hatfield State Park
15	Merced River	Merced River near the town of Hopeton
11	Mill Creek	Mill Creek near Sacramento River
16	Mokelumne River	Woodbridge Irrigation District Dam
27	Sacramento River	Balls Ferry
25	Sacramento River	Glenn Colusa Irrigation Diversion
17	Sacramento River	Knights Landing
18	Sacramento River	Red Bluff Diversion Dam
19	Stanislaus River	Caswell State Park
24	Stanislaus River	Stanislaus River near the town of Oakdale
21	Tuolumne River	Grayson Ranch
20	Tuolumne River	Shiloh Bridge
23	Tuolumne River	Tuolumne River near the town of Waterford
22	Yuba River	Hallwood Boulevard

Maps where rotary screw traps have been deployed at 27 locations in the Central Valley.

Red dots indicate locations where rotary screw traps have been deployed.





Information summaries for rotary screw traps in the Central Valley

Locations where rotary screw traps have been operated in the Central Valley since 1992

Watershed	Trap location	UTM NAD83 zone 10	UTM NAD83 zone 10
American River	Watt Avenue	640400	4269900
Battle Creek	Battle Creek - Lower Trap	568955	4470825
Battle Creek	Battle Creek - Upper Trap	572856	4472316
Big Chico Creek	Bidwell Park Municipal Golf Course	604600	4402700
Butte Creek	Maddock Road	617091	4301820
Butte Creek	Parrott - Phalen Diversion Dam	607120	4396256
Clear Creek	Clear Creek - Lower Trap	551188	4484095
Clear Creek	Clear Creek - Upper Trap	542676	4482509
Cosumnes River	Folsom South Canal Crossing	656093	4257504
Deer Creek	Deer Creek near Sacramento River confluence	588704	4429491
Feather River	High Flow Channel - Sunset Pumps	617661	4345064
Feather River	Low Flow Channel - Steep Riffle	620089	4368987
Merced River	Hagaman State Park	690448	4137561
Merced River	Hatfield State Park	680643	4136134

Locations where rotary screw traps have been operated in the Central Valley since 1992

Watershed	Trap location	UTM NAD83 zone 10	UTM NAD83 zone 10
Merced River	Merced River near the town of Hopeton	715190	4149865
Mill Creek	Mill Creek near Sacramento River confluence	582847	4434284
Mokelumne River	Woodbridge Irrigation District Dam	649153	4224599
Sacramento River	Balls Ferry	567200	4476900
Sacramento River	Glenn Colusa Irrigation Diversion	581483	4404848
Sacramento River	Knights Landing	612991	4295639
Sacramento River	Red Bluff Diversion Dam	567950	4445040
Stanislaus River	Caswell State Park	660479	4174348
Stanislaus River	Stanislaus River near the town of Oakdale	687801	4182546
Tuolumne River	Grayson Ranch	665375	4161526
Tuolumne River	Shiloh Bridge	664900	4163400
Tuolumne River	Tuolumne River near the town of Waterford	695334	4165978
Yuba River	Hallwood Boulevard	628509	4337924

Locations where rotary screw traps have been operated in the Central Valley since 1992

Chronology of when rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
American River	Watt Avenue	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Battle Creek	Battle Creek - Lower Trap	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Battle Creek - Upper Trap	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Big Chico Creek	Bidwell Park Municipal Golf Course	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Butte Creek	Maddock Road	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Parrott - Phalen Diversion Dam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Chronology of when rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Clear Creek																			
	Clear Creek - Lower Trap	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Clear Creek - Upper Trap	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cosumnes River																			
	Folsom South Canal Crossing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deer Creek																			
	Deer Creek near Sacramento River	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Feather River																			
	High Flow Channel - Sunset Pumps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Low Flow Channel - Steep Riffle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Merced River																			
	Hagaman State Park	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Chronology of when rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Merced River																			
	Hatfield State Park	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Merced River near the town of Hopeton	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mill Creek																			
	Mill Creek near Sacramento River	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mokelumne River																			
	Woodbridge Irrigation District Dam	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sacramento River																			
	Balls Ferry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Glenn Colusa Irrigation Diversion	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Knights Landing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Red Bluff Diversion Dam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Chronology of when rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Stanislaus River																			
	Caswell State Park	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Stanislaus River near the town of Oakdale	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Tuolumne River																			
	Grayson Ranch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Shiloh Bridge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Tuolumne River near the town of Waterford	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Yuba River																			
	Hallwood Boulevard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Chronology of when rotary screw traps were operated in the Central Valley since 1992

Reasons why rotary screw traps were operated in the Central Valley since 1992

watershed	Trap location:	quantify total juvenile salmon production	assess relative juvenile salmon abundance	monitor juvenile salmon outmigration timing	compare environmental factors with juvenile salmon abundance	collect juvenile salmon life history data
American River						
	Watt Avenue	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Battle Creek						
	Battle Creek - Lower Trap	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Battle Creek - Upper Trap	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Big Chico Creek						
	Bidwell Park Municipal Golf Course	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Reasons why rotary screw traps were operated in the Central Valley since 1992

watershed	Trap location:	quantify total juvenile salmon production	assess relative juvenile salmon abundance	monitor juvenile salmon outmigration timing	compare environmental factors with juvenile salmon abundance	collect juvenile salmon life history data
Butte Creek						
	Maddock Road	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Parrott - Phalen Diversion Dam	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Clear Creek						
	Clear Creek - Lower Trap	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Clear Creek - Upper Trap	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cosumnes River						
	Folsom South Canal Crossing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deer Creek						
	Deer Creek near Sacramento River confluence	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Reasons why rotary screw traps were operated in the Central Valley since 1992

watershed	Trap location:	quantify total juvenile salmon production	assess relative juvenile salmon abundance	monitor juvenile salmon outmigration timing	compare environmental factors with juvenile salmon abundance	collect juvenile salmon life history data
Feather River						
	High Flow Channel - Sunset Pumps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Low Flow Channel - Steep Riffle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Merced River						
	Hagaman State Park	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Hatfield State Park	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Merced River near the town of Hopeton	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mill Creek						
	Mill Creek near Sacramento River confluence	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Reasons why rotary screw traps were operated in the Central Valley since 1992

watershed	Trap location:	quantify total juvenile salmon production	assess relative juvenile salmon abundance	monitor juvenile salmon outmigration timing	compare environmental factors with juvenile salmon abundance	collect juvenile salmon life history data
Mokelumne River						
	Woodbridge Irrigation District Dam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sacramento River						
	Balls Ferry	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Glenn Colusa Irrigation Diversion	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Knights Landing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Red Bluff Diversion Dam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Stanislaus River						
	Caswell State Park	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Reasons why rotary screw traps were operated in the Central Valley since 1992

watershed	Trap location:	quantify total juvenile salmon production	assess relative juvenile salmon abundance	monitor juvenile salmon outmigration timing	compare environmental factors with juvenile salmon abundance	collect juvenile salmon life history data
Stanislaus River						
	Stanislaus River near the town of Oakdale	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Tuolumne River						
	Grayson Ranch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Shiloh Bridge	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Tuolumne River near the town of Waterford	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Yuba River						
	Hallwood Boulevard	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Reasons why rotary screw traps were operated in the Central Valley since 1992

Points of contact for rotary screw traps that have been operated in the Central Valley since 1992

Watershed	Trap location	Entity that does the trapping at the trap location	Point of contact	Phone number	Email
American River	Watt Avenue	California Department of Fish and Game	Robert Vincik	(916) 358-2933	rvincik@dfg.ca.gov
Battle Creek	Battle Creek - Lower Trap	U.S. Fish and Wildlife Service	Kellie Whitton	(530) 527-3043 Ext. 245	kellie_whitton@fws.gov
	Battle Creek - Upper Trap	U.S. Fish and Wildlife Service	Kellie Whitton	(530) 527-3043 Ext. 245	kellie_whitton@fws.gov
Big Chico Creek	Bidwell Park Municipal Golf Course	California Department of Fish and Game	Tracy McReynolds	(530) 895-5111	tmcreynolds@dfg.ca.gov
Butte Creek	Maddock Road	California Department of Fish and Game	Tracy McReynolds	(530) 895-5111	tmcreynolds@dfg.ca.gov

Points of contact for rotary screw traps that have been operated in the Central Valley since 1992

Watershed	Trap location	Entity that does the trapping at the trap location	Point of contact	Phone number	Email
Butte Creek	Parrott - Phalen Diversion Dam	California Department of Fish and Game	Tracy McReynolds	(530) 895-5111	tmcreynolds@dfg.ca.gov
Clear Creek	Clear Creek - Lower Trap	U.S. Fish and Wildlife Service	Matt Brown	(530) 527-3043	Matt_Brown@fws.gov
	Clear Creek - Upper Trap	U.S. Fish and Wildlife Service	Matt Brown	(530) 527-3043	Matt_Brown@fws.gov
Cosumnes River	Folsom South Canal Crossing	California Department of Fish and Game	none		
Deer Creek	Deer Creek near Sacramento River confluence	California Department of Fish and Game	Colleen Harvey Arrison	(530) 527-9490	charvey@dfg.ca.gov
Feather River	High Flow Channel - Sunset Pumps	California Department of Water Resources	Jason Kindopp	(530) 534-2381	jkindopp@water.ca.gov

Points of contact for rotary screw traps that have been operated in the Central Valley since 1992

Watershed	Trap location	Entity that does the trapping at the trap location	Point of contact	Phone number	Email
Feather River	Low Flow Channel - Steep Riffle	California Department of Water Resources	Jason Kindopp	(530) 534-2381	jkindopp@water.ca.gov
Merced River	Hagaman State Park	California Department of Fish and Game	Tim Heyne	(209) 853-2533	theyne@dfg.ca.gov
	Hatfield State Park	Cramer Fish Sciences	Clark Watry	(209) 847-7786	clarkw@fishsciences.net
	Merced River near the town of Hopeton	Natural Resources Scientists, Inc.	Dave Vogel	(530) 527-9587	dvogel@resourcescientists.com
Mill Creek					
	Mill Creek near Sacramento River confluence	California Department of Fish and Game	Colleen Harvey Arrison	(530) 527-9490	charvey@dfg.ca.gov
Mokelumne River					
	Woodbridge Irrigation District Dam	East Bay Municipal Utility District	Robyn Bilski	(209) 333-2095 Ext. 236	rbilski@ebmud.com

Points of contact for rotary screw traps that have been operated in the Central Valley since 1992

Watershed	Trap location	Entity that does the trapping at the trap location	Point of contact	Phone number	Email
Sacramento River	Balls Ferry	California Department of Fish and Game	Robert Titus	(916) 227-6390	rtitus@dfg.ca.gov
	Glenn Colusa Irrigation Diversion	California Department of Fish and Game	Diane Coulon	(530) 895-5002	dcoulon@dfg.ca.gov
	Knights Landing	California Department of Fish and Game	Robert Vincik	(916) 358-2933	rvincik@dfg.ca.gov
	Red Bluff Diversion Dam	U.S. Fish and Wildlife Service	Bill Poytress	(530) 527-3043 Ext. 231	bill_poytress@fws.gov
Stanislaus River	Caswell State Park	Cramer Fish Sciences	Clark Watry	(209) 847-7786	clarkw@fishsciences.net
	Stanislaus River near the town of Oakdale	FISHBIO Environmental, LLC	Chrissy L. Sonke	(209) 614-0813	chrissysonke@fishbio.com

Points of contact for rotary screw traps that have been operated in the Central Valley since 1992

Watershed	Trap location	Entity that does the trapping at the trap location	Point of contact	Phone number	Email
Tuolumne River	Grayson Ranch	California Department of Fish and Game / FISHBIO	Tim Heyne / Andrea Fuller	(209) 853-2533 / (209) 840-4845	theyne@dfg.ca.gov / andreafuller@fishbio.com
	Shiloh Bridge	California Department of Fish and Game	Tim Heyne	(209) 853-2533	theyne@dfg.ca.gov
	Tuolumne River near the town of Waterford	FISHBIO Environmental, LLC	Chrissy L. Sonke	(209) 614-0813	chrissysonke@fishbio.com
Yuba River	Hallwood Boulevard	Pacific States Marine Fisheries Commission	Duane Massa	(530) 570-3474	duane@psmfc.org

Points of contact for rotary screw traps that have been operated in the Central Valley since 1992

A summary of how rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	Are trap efficiency tests done at the trap location?	Number of traps at the trap location	Normal start of field season	Normal end of field season
American River	Watt Avenue	yes	usually 2	November	July
Battle Creek	Battle Creek - Lower Trap	yes	always 1	November	June
	Battle Creek - Upper Trap	yes	always 1	October	September
Big Chico Creek					
	Bidwell Park Municipal Golf Course	no	always 1	November	May
Butte Creek					
	Maddock Road	no	usually 1	highly variable	June
	Parrott - Phalen Diversion Dam	no	always 1	October	June

A summary of how rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	Are trap efficiency tests done at the trap location?	Number of traps at the trap location	Normal start of field season	Normal end of field season
Clear Creek	Clear Creek - Lower Trap	yes	always 1	January	December
	Clear Creek - Upper Trap	yes	always 1	January	December
Cosumnes River	Folsom South Canal Crossing	no	always 1	April	June
Deer Creek	Deer Creek near Sacramento River confluence	no	always 1	October	June
Feather River	High Flow Channel - Sunset Pumps	yes	usually 2	December	June
	Low Flow Channel - Steep Riffle	yes	always 1	December	June

A summary of how rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	Are trap efficiency tests done at the trap location?	Number of traps at the trap location	Normal start of field season	Normal end of field season
Merced River	Hagaman State Park	not documented	usually 1	January	May
	Hatfield State Park	yes	usually 2	March	June
	Merced River near the town of Hopeton	yes	always 2	January	June
Mill Creek	Mill Creek near Sacramento River confluence	no	always 1	October	June
Mokelumne River	Woodbridge Irrigation District Dam	yes	usually 2	December	June
Sacramento River	Balls Ferry	yes	usually 2	October	September
	Glenn Colusa Irrigation Diversion	no	always 1	January	December

A summary of how rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	Are trap efficiency tests done at the trap location?	Number of traps at the trap location	Normal start of field season	Normal end of field season
Sacramento River	Knights Landing	yes	usually 2	October	June
	Red Bluff Diversion Dam	yes	usually 4	January	December
Stanislaus River	Caswell State Park	yes	usually 2	December	June
	Stanislaus River near the town of Oakdale	yes	always 1	January	June
Tuolumne River	Grayson Ranch	yes	usually 2	January	June
	Shiloh Bridge	yes	usually 2	April	June
	Tuolumne River near the town of Waterford	yes	always 1	January	June

A summary of how rotary screw traps were operated in the Central Valley since 1992

Watershed	Trap location	Are trap efficiency tests done at the trap location?	Number of traps at the trap location	Normal start of field season	Normal end of field season
Yuba River	Hallwood Boulevard	yes	usually 2	October	June

A summary of how rotary screw traps were operated in the Central Valley since 1992

An overview of the Chinook salmon caught by rotary screw traps in the Central Valley since 1992

Watershed	Trap location	Chinook salmon runs present in the watershed:	Which life stages are used to classify fish?	Is a fish hatchery upstream of the RST?
American River	Watt Avenue	fall- and spring-run	yolk sac fry, fry, parr, silvery parr, smolts	yes
Battle Creek	Battle Creek - Lower Trap	fall-, late fall-, spring-, and winter-run	fry, parr, silvery parr, smolts	yes
	Battle Creek - Upper Trap	fall-, late fall-, and spring-run	yolk sac fry, fry, parr, silvery parr, smolt	no
Big Chico Creek	Bidwell Park Municipal Golf Course	fall-, late fall-, and spring-run	young of the year, yearlings	no
Butte Creek	Maddock Road	fall-, late fall-, and spring-run	young of the year, yearlings	no
	Parrott - Phalen Diversion Dam	fall-, late fall-, and spring-run	young of the year, yearlings	no

An overview of the Chinook salmon caught by rotary screw traps in the Central Valley since 1992

Watershed	Trap location	Chinook salmon runs present in the watershed:	Which life stages are used to classify fish?	Is a fish hatchery upstream of the RST?
Clear Creek	Clear Creek - Lower Trap	fall-, late fall-, and spring-run	fry, parr, silvery parr, smolts	no
	Clear Creek - Upper Trap	spring-run	fry, parr, silvery parr, smolts	no
Cosumnes River	Folsom South Canal Crossing	fall-run	salmon are not classified according to	no
Deer Creek	Deer Creek near Sacramento River confluence	fall- and spring-run	young of the year, yearlings	no
Feather River	High Flow Channel - Sunset Pumps	fall-, late fall-, and spring-run	yolk sac fry, fry, parr, intermediate, smolt	yes
	Low Flow Channel - Steep Riffle	fall-, late fall-, and spring-run	yolk sac fry, fry, parr, intermediate, smolt	yes

An overview of the Chinook salmon caught by rotary screw traps in the Central Valley since 1992

Watershed	Trap location	Chinook salmon runs present in the watershed:	Which life stages are used to classify fish?	Is a fish hatchery upstream of the RST?
Merced River	Hagaman State Park	fall-run	not documented	yes
	Hatfield State Park	fall-run	yolk sac fry, fry, parr, silvery parr, smolts	yes
	Merced River near the town of Hopeton	fall-run	fry, juvenile (intermediate), smolt	yes
Mill Creek	Mill Creek near Sacramento River confluence	fall- and spring-run	young of the year, yearlings	no
Mokelumne River	Woodbridge Irrigation District Dam	fall-run	yolk sac fry, fry, parr, silvery parr, smolts	yes
Sacramento River	Balls Ferry	fall-, late fall-, spring-, and winter-run	salmon are not classified according to	yes
	Glenn Colusa Irrigation Diversion	fall-, late fall-, spring-, and winter-run	salmon are not classified according to	yes

An overview of the Chinook salmon caught by rotary screw traps in the Central Valley since 1992

Watershed	Trap location	Chinook salmon runs present in the watershed:	Which life stages are used to classify fish?	Is a fish hatchery upstream of the RST?
Sacramento River				
	Knights Landing	fall-, late fall-, spring-, and winter-run	yolk sac fry, fry, parr, silvery parr, smolt	yes
	Red Bluff Diversion Dam	fall-, late fall-, spring-, and winter-run	fry, pre-smolt/smolts	yes
Stanislaus River				
	Caswell State Park	fall-run	yolk sac fry, fry, parr, silvery parr, smolt,	no
	Stanislaus River near the town of Oakdale	fall-run	fry, parr, smolt	no
Tuolumne River				
	Grayson Ranch	fall-run	yolk sac fry, fry, parr, smolt, yearling	no
	Shiloh Bridge	fall-run	salmon are not classified according to	no
	Tuolumne River near the town of Waterford	fall-run	fry, parr, smolts	no

An overview of the Chinook salmon caught by rotary screw traps in the Central Valley since 1992

Watershed	Trap location	Chinook salmon runs present in the watershed:	Which life stages are used to classify fish?	Is a fish hatchery upstream of the RST?
Yuba River	Hallwood Boulevard	fall- and spring-run	yolk sac fry, fry, parr, silvery parr, smolts	no

An overview of the Chinook salmon caught by rotary screw traps in the Central Valley since 1992

Individual descriptions for rotary screw traps in the Central Valley

BASIC SITE INFORMATION

Watershed: American River.

Trap location: Watt Avenue.

CAMP rotary screw trap number: 1.

River mile at trap location: 9.

UTM NAD83 zone 10 easting: 640400.

UTM NAD83 zone 10 northing: 4269900.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Robert Vincik.

Phone number: (916) 358-2933.

Email: rvincik@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall- and spring-run.

Data for the following years is presented in an annual report: 1994, 1995, 1996, 1997, 1998, 1999.

Year trapping started: 1993.

Normal start of field season: November.

Normal end of field season: July.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: all of the Chinook salmon were assumed to be fall-run salmon because the number of salmon belonging to other runs is negligible.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolts.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? no.

Are traps raised when they are not being serviced? yes, during the weekends.

How many times a day is the trap serviced? once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 150.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? 5 - 10 times a field season.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 0 - 2%.

Description of trap efficiency tests: trap efficiency tests were done each year. It was not uncommon to mark a few thousand salmon each efficiency test but recover such a small number that the trap efficiency was only 1 - 2%.

Trap efficiency notes: an estimate of the total number of salmon emigrating past the trap site was made by dividing the expanded catch (to account for time during weeks when trapping occurred less than 100% of the time) by mean trap efficiency. Weekly catches were expanded by multiplying the total number of potential trap hours for the week (e.g., 336 hours per week for two traps) by the corresponding weekly catch rate.

The authors suspect that river flow is the primary determinant of trap efficiency.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? salmon numbers were expanded for days not fished, but the methods for doing this were not described in annual reports.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? no.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? no.

Are the formulas used to develop variance and confidence intervals reported? no.

Miscellaneous notes:

- 1) The mean of weekly trap efficiencies across the entire trapping season were used to extrapolate daily catches to weekly totals that were then summed for an annual total. This estimated total number of emigrants is intended to be used as an index of emigration rather than an absolute measurement.
- 2) Trap size has varied somewhat over the years, i.e., sometimes 5-foot diameter traps were used and sometimes 8-foot diameter traps were used.
- 3) In some years, the traps were fished side by side, and in other years the individual traps were separated by a few dozen meters.
- 4) Trap efficiencies were typically low, on the order of 1 - 2%.
- 5) The traps were not typically operated in an intensive fashion, i.e., they may only have been operated and serviced 4 days/week.
- 6) There are two runs in the watershed (fall- and spring-run), but very few (<200) spring-run Chinook salmon were caught each year compared to thousands or tens of thousands of fall-run Chinook salmon.
- 7) Annual reports do not mention the collection of data that can be used to assess trap reliability, e.g. identifying days when traps did not function due to debris, monitoring the number of trap revolutions per day, etc.

- 8) A fish hatchery is present in the American River watershed. To accurately monitor the production of wild juvenile Chinook salmon, there needs to be a way to discriminate between wild- and hatchery-produced juvenile Chinook salmon. If it is not possible to discriminate between the two types of juvenile salmon, it will be difficult to accurately quantify the number of juvenile Chinook salmon that are naturally produced in the American River.
- 9) Trapping activities on the American River with a RST were discontinued by the California Department of Fish and Game after the 2008 trapping season.

BASIC SITE INFORMATION

Watershed: Battle Creek.

Trap location: Battle Creek - Lower Trap.

CAMP rotary screw trap number: 3.

River mile at trap location: 2.8.

UTM NAD83 zone 10 easting: 568955.

UTM NAD83 zone 10 northing: 4470825.

Entity that does the trapping at the trap location: U.S. Fish and Wildlife Service.

Point of contact: Kellie Whitton.

Phone number: (530) 527-3043 Ext. 245.

Email: kellie_whitton@fws.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, spring-, and winter-run.

Data for the following years is presented in an annual report: 1998 - 2001, 2002, 2003, 2004, 2005, 2006.

Year trapping started: 1998.

Normal start of field season: November.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 4.

Life stages used to classify salmon: fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? once, more as needed.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a water displacement method when large numbers of salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 150.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? sometimes as frequently as 10 - 30 times a season.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: see the annual Battle Creek RST reports for a comprehensive overview of the methods used. The methods do vary by year, e.g. the methods used in the 1999 - 2000 field season were not the same as 2000 - 2001. It will be necessary to look at each report to determine how the efficiency test methods varied by year.

Trap efficiency notes: stream discharge was not used to predict trap efficiency.

Week trap efficiency estimates were used to develop weekly production estimates.

Trap efficiency = number recaptures / number of marked salmon released; salmon production = weekly catch / weekly trap efficiency.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped was used to estimate catch.

Are half-cone modifications used at the trap location? yes, but not on every day during a field season.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 90 and 95% confidence intervals are presented in annual RST reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) Trapping at this location ceased after 2006.
- 2) Half cone operations were sometimes used at this RST trapping location. When this operation was used, 1/2 of the mouth of the RST was blocked, and the number of salmon captured by the RST was reduced. This practice was used to reduce the number of spring-run Chinook salmon that were captured.
- 3) A large number of trap efficiency tests (e.g. 15+) were routinely done at this location each year. It was not uncommon for two trap efficiency tests to be done each week.
- 4) Because length at date criteria were used to determine salmon run at this location, the reported number of spring-run Chinook salmon may have been under-estimated and the reported number of fall-run Chinook salmon may have been over-estimated.
- 5) High flows during the 2005 - 2006 field season strongly affected RST operations and it was not possible to develop salmon production estimates.
- 6) There was an attempt to operate the RST under high discharge conditions to assess salmon passage in those conditions.
- 7) A subsampling method was infrequently used to estimate the number of salmon caught when large numbers of salmon were present. See the Battle Creek RST reports for an explanation of the subsampling method.

- 8) Wild salmon were most commonly used for trap efficiency tests. On infrequent occasions, hatchery salmon were also used for trap efficiency tests.
- 9) In some cases, multiple trap efficiency tests were pooled to develop weekly production estimates.
- 10) A fish hatchery exists in the Battle Creek watershed. The presence of the hatchery complicates the effort to develop juvenile salmon production estimates because many of the salmon that have been released from the hatchery were not marked, and those unmarked salmon were oftentimes indistinguishable from wild juvenile Chinook salmon.
- 11) Trap efficiency data from multiple tests within a given week were pooled to create a composite efficiency estimate for that week. If less than seven salmon were captured during efficiency tests in a given week, efficiency data from two weeks were combined to develop an overall trap efficiency estimate.
- 12) The months when trapping began and ended varied over time, e.g., trapping in some years began earlier or later than November.

BASIC SITE INFORMATION

Watershed: Battle Creek.

Trap location: Battle Creek - Upper Trap.

CAMP rotary screw trap number: 2.

River mile at trap location: 5.9.

UTM NAD83 zone 10 easting: 572856.

UTM NAD83 zone 10 northing: 4472316.

Entity that does the trapping at the trap location: U.S. Fish and Wildlife Service.

Point of contact: Kellie Whitton.

Phone number: (530) 527-3043 Ext. 245.

Email: kellie_whitton@fws.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 1998 - 2001, 2002, 2003, 2004, 2005, 2006, 2008.

Year trapping started: 1998.

Normal start of field season: October.

Normal end of field season: September.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: see notes in the Data Processing section below.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, more as needed.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a subsampling method when large numbers of salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 150.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? sometimes as frequently as 10 - 30 times a season.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 6 - 10%.

Description of trap efficiency tests: see the annual Battle Creek RST reports for a comprehensive overview of the methods used. The methods do vary by year, e.g. the methods used in the 1999 - 2000 field season were not the same as 2000 - 2001. It will be necessary to look at each report to determine how the efficiency test methods varied by year.

Trap efficiency notes: stream discharge is not used to predict trap efficiency.

Week trap efficiency estimates are used to develop weekly production estimates.

Trap efficiency = number recaptures / number of marked salmon released; salmon production = weekly catch / weekly trap efficiency.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped are used to estimate catch.

Are half-cone modifications used at the trap location? yes, but not on every day during a field season.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 90 and 95% confidence intervals are presented in annual RST reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) Half cone operations are sometimes used at this RST trapping location. When this operation is used, 1/2 of the mouth of the RST is blocked, and the number of salmon captured by the RST is reduced. This practice is used to reduce the number of spring-run Chinook salmon that are captured.
- 2) A large number of trap efficiency tests (e.g. 15+) are routinely done at this location each year. It is not uncommon for two trap efficiency tests to be done each week.
- 3) Three factors have been used to varying degrees to assign individual salmon to a particular run. Earlier RST reports may have entirely relied on length at date criteria to determine salmon run; these criteria may not be entirely applicable to Battle Creek due to differences in water temperatures between Battle Creek and the Sacramento River. Later RST reports also rely on run timing or when redds were last observed in the creek to assign individual salmon to a run.
- 4) Because earlier RST reports used length at date criteria to assign salmon to a particular run, the number of spring-run Chinook salmon in those reports may have been under-estimated and the number of fall-run Chinook may have been over-estimated.
- 5) High flows during the 2005 - 2006 field season strongly affected RST operations and it was not possible to develop salmon production estimates.
- 6) The RST is commonly checked two or more times per day when environmental conditions warrant such action.

- 7) On rare occasions when large numbers of salmon are caught, each individual salmon may not be counted and subsampling may instead be used to estimate the total number of salmon captured.
- 8) Wild salmon are most commonly used for trap efficiency tests. On infrequent occasions, hatchery salmon are used to estimate trap efficiency.
- 9) Trap efficiencies less than 6% occasionally occur, particularly when a half-cone operation exists.
- 10) There are attempts to operate the RST under high discharge conditions to assess salmon numbers in those conditions.
- 11) The construction of a barrier weir at the Coleman National Fish Hatchery in 2008 will reduce the likelihood that fall-run Chinook salmon are captured by the upper Battle Creek RST. Fall-run salmon may, however, be able to circumvent the weir during high discharge conditions. The bulk of the salmon caught at this location are therefore late fall run- or spring-run Chinook salmon.
- 12) Trap efficiency data from multiple tests within a given week may be pooled to create a composite efficiency estimate for that week. If less than seven salmon are captured during efficiency tests in a given week, efficiency data from two weeks may be combined to develop an overall trap efficiency estimate.
- 13) The upper Battle Creek RST is located above the Coleman National Fish Hatchery. Most of the salmon caught at this site are therefore likely to be of wild origin.
- 14) The months when trapping began and ended have varied over time, i.e., trapping in some years began in September instead of October. At the present time, trapping at the upper Battle Creek RST begins between mid-November and early December and ends ~ June 30.
- 15) Between 2005 and 2006, a RST was operated in Battle Creek at the Powerhouse Battle Creek site.

BASIC SITE INFORMATION

Watershed: Big Chico Creek.

Trap location: Bidwell Park Municipal Golf Course.

CAMP rotary screw trap number: 4.

River mile at trap location: 12.

UTM NAD83 zone 10 easting: 604600.

UTM NAD83 zone 10 northing: 4402700.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Tracy McReynolds.

Phone number: (530) 895-5111.

Email: tmcreynolds@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 1998 - 2000, 2001, 2002, 2003.

Year trapping started: 1998.

Normal start of field season: November.

Normal end of field season: May.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: annual reports do not discriminate between runs, i.e., they only report the total number of Chinook salmon captured.

Number of life stages monitored: 2.

Life stages used to classify salmon: young of the year, yearling.

Method used to classify immature salmon according to life stage: a distinct break in the length frequency of captured salmon was used to separate captured salmon into young-of-the-year and yearling life stages.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes, e.g., traps were raised during periods with high discharge.

How many times a day is the trap serviced? once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests were not done in Big Chico Creek.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon were not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? not applicable.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) Fall-run and spring-run Chinook salmon occur in Big Chico Creek.
- 2) The number of juvenile salmon that were captured were a combination of spring- and fall-run Chinook salmon.
- 3) There was no attempt to develop production estimates of juvenile salmon in this watershed; there are only numbers to suggest relative abundance.
- 4) Trap efficiency tests were not done in the watershed.
- 5) The number of captured juvenile salmon from Big Chico Creek did not exceed 2,000 fish/year in the five years when monitoring was done.
- 6) The lengths of a maximum of 50 randomly selected fish were measured each day.

BASIC SITE INFORMATION

Watershed: Butte Creek.

Trap location: Maddock Road.

CAMP rotary screw trap number: 5.

River mile at trap location: 7.

UTM NAD83 zone 10 easting: 617091.

UTM NAD83 zone 10 northing: 4301820.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Tracy McReynolds.

Phone number: (530) 895-5111.

Email: tmcreynolds@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 2001, 2002, 2003, 2004.

Year trapping started: 2000.

Normal start of field season: highly variable.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 1.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: annual reports do not discriminate between runs, i.e., they only report the total number of Chinook salmon captured.

Number of life stages monitored: 2.

Life stages used to classify salmon: young of the year, yearling.

Method used to classify immature salmon according to life stage: a distinct break in the length frequency of captured salmon was used to separate captured salmon into young-of-the-year and yearling life stages.

Is there an effort to operate traps 7 days/week? in some years yes, in some years no.

Are traps raised when they are not being serviced? yes, e.g. traps were raised during periods with high discharge.

How many times a day is the trap serviced? usually once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests were not done in Butte Creek.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon were not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? in a general way through 1-line narratives in the annual Butte Creek RST reports, e.g. "debris was a problem on X date".

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) The California Department of Fish and Game discontinued trapping at this location in 2004.
- 2) There was not an ability to discriminate between different runs of Chinook salmon at this location because multiple runs were present.
- 3) Many of the wild juvenile Chinook salmon caught at Maddock Road were previously caught by the RST at the Parrott-Phelan Diversion Dam; some of these wild salmon were marked with a coded wire tag, released, and subsequently re-captured at Maddock Road. There should be an effort to determine if the tally of captured salmon at Maddock Road includes coded wire tagged salmon, or if it only includes unmarked salmon.
- 4) Water velocity in meters per second (m/s) was measured in front of the trap each day and screw trap cone revolutions were recorded by a mechanical counter. These data are not presented in the RST reports, however.
- 5) When flows in the Sacramento River are greater than approximately 21,000 cubic feet per second (CFS) at Wilkins Slough, part of the Sacramento River flows into lower Butte Creek and the Sutter Bypass through the Tisdale Weir. When water is bypassed, outmigrating salmonids from the upper Sacramento River mix with spring-run Chinook salmon from Butte Creek.

BASIC SITE INFORMATION

Watershed: Butte Creek.

Trap location: Parrott - Phalen Diversion Dam.

CAMP rotary screw trap number: 6.

River mile at trap location: 44.

UTM NAD83 zone 10 easting: 607120.

UTM NAD83 zone 10 northing: 4396256.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Tracy McReynolds.

Phone number: (530) 895-5111.

Email: tmcreynolds@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 1996 - 1998, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.

Year trapping started: 1995.

Normal start of field season: October.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: see notes in the Data Processing section below.

Number of life stages monitored: 2.

Life stages used to classify salmon: young of the year, yearling.

Method used to classify immature salmon according to life stage: a distinct break in the length frequency of captured salmon was used to separate captured salmon into young-of-the-year and yearling life stages.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes, e.g., traps were raised during periods with high discharge.

How many times a day is the trap serviced? once, but sometimes more frequently during periods with high debris.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests were not done in Butte Creek.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon were not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes, e.g., appendices in the annual Butte Creek RST reports show when trapping was terminated due to high debris.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? not applicable.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) The California Department of Fish and Game discontinued trapping at this location in 2008.
- 2) A diversion screen also was operated adjacent to the RST at the Parrott Phelan Diversion Dam. The screen also captured juvenile salmon. It is necessary to combine the counts from the screen and the RST to estimate how many juvenile salmon were caught at the PPDD.
- 3) In some years, two RSTs were operated at the PPDD so the number of salmon caught would be higher in those years. Without taking this into account, there could be a false impression that the creek was producing more fish in some years.
- 4) High discharge events substantially affected RST operations and the RST may have been inoperable for several days.
- 5) Some fall-run Chinook salmon spawn upstream of this site. However, the majority of fall-run Chinook salmon occur downstream of this site. Most of the Chinook salmon caught at this site were probably spring-run Chinook salmon.
- 6) The months when trapping occurred varied by year.
- 7) In some years (e.g., 2003), small numbers of fall-run Chinook salmon spawned above the RST so the captured juvenile fish were a blend of fall- and spring-run salmon.
- 8) Some of the putative spring-run juvenile Chinook salmon caught at this site could have been late fall-run Chinook salmon.
- 9) Water velocity in meters per second (m/s) was measured in front of the trap each day and screw trap cone revolutions were recorded through the use of a mechanical counter. These data are not presented in RST reports.
- 10) Some of the wild Chinook salmon captured at this site received a coded wire tag (CWT).

BASIC SITE INFORMATION

Watershed: Clear Creek.

Trap location: Clear Creek - Lower Trap.

CAMP rotary screw trap number: 8.

River mile at trap location: 1.7.

UTM NAD83 zone 10 easting: 551188.

UTM NAD83 zone 10 northing: 4484095.

Entity that does the trapping at the trap location: U.S. Fish and Wildlife Service.

Point of contact: Matt Brown.

Phone number: (530) 527-3043.

Email: Matt_Brown@fws.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 1999 - 2000, 2002, 2003, and 2007.

Year trapping started: 1998.

Normal start of field season: January.

Normal end of field season: December.

Has the sampling always taken place at the same location: not documented.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 4.

Life stages used to classify salmon: fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: Clear Creek RST annual reports do not state how life stage is determined.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, and more than once as conditions warrant.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a subsampling method when more than 250 salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 250.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? twice weekly.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: staff attempt to mark at least 400 salmon during each efficiency test. The goal during each trap efficiency test is to recapture at least 7 of the marked salmon that were released. The techniques used to mark salmon has varied over time. The process where trap efficiency tests were used to develop production estimates has varied substantially over time (see page 13 of the 2001 - 2002 Battle Creek RST report as an example). Changes in these processes should be analyzed to determine if these changes affect production estimates.

Trap efficiency notes: the salmon that are used during trap efficiency tests are marked using two methods. They are marked with Bismark brown stain, and then a portion of the upper or lower caudal fin is clipped.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped are used to estimate catch.

Are half-cone modifications used at the trap location? yes, but not on every day during a field season.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 90 and 95% confidence intervals are presented in annual RST reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) Trap efficiency results have been used in a variety of ways over the years to develop annual salmon production estimates.
- 2) Half cone operations are sometimes used at this RST trapping location. When this operation is used, 1/2 of the mouth of the RST is blocked, and the number of fish captured by the RST is reduced. This practice is used to reduce the number of spring-run Chinook salmon that are captured.
- 3) A picket weir was installed in Clear Creek in some, but not all, years when rotary screw trap operations were taking place in Clear Creek. The weir has been installed to prevent fall-run Chinook salmon from accessing areas where spring-run Chinook salmon could spawn. This action affected the number of river miles where fall-run Chinook salmon could spawn, and therefore may have affected the number of fall-run Chinook salmon produced by the creek. An analysis that evaluates the effects of the weir installation should be conducted before trends in salmon numbers are assessed. The weir's location has changed over time and this may have affected the production estimates of different runs of Chinook salmon.
- 4) The lower Clear Creek RST captures fall-, late fall-, and spring-run Chinook salmon.
- 5) Water releases from Whiskeytown Dam above the RST trapping location can affect the number of juvenile salmon that are captured.
- 6) The use of length at date criteria to assign salmon run suggests winter-run Chinook salmon are present in Clear Creek. U.S. Fish and Wildlife Service biologists do not believe this run is present in Clear Creek, however.
- 7) Subsampling is used to estimate the daily catch when more than 250 juvenile salmon are caught. This can create an overestimation of the number of fish caught. One of the Clear Creek RST reports mentions this at length.

- 8) The lower Clear Creek RST trapping location may have changed over time.
- 9) Juvenile salmon were classified according to life stage but the methods for assigning fish to a particular life stage are not described in the RST reports.
- 10) The USFWS staff that operate the lower Clear Creek RST did not provide peer review comments on the data summary pertaining this trapping location. The summary in this CAMP reference was therefore based on narratives in four Clear Creek RST annual reports.

BASIC SITE INFORMATION

Watershed: Clear Creek.

Trap location: Clear Creek - Upper Trap.

CAMP rotary screw trap number: 9.

River mile at trap location: 8.3.

UTM NAD83 zone 10 easting: 542676.

UTM NAD83 zone 10 northing: 4482509.

Entity that does the trapping at the trap location: U.S. Fish and Wildlife Service.

Point of contact: Matt Brown.

Phone number: (530) 527-3043.

Email: Matt_Brown@fws.gov.

Chinook salmon runs present in the watershed: spring-run.

Data for the following years is presented in an annual report: 2007.

Year trapping started: 2006.

Normal start of field season: January.

Normal end of field season: December.

Has the sampling always taken place at the same location: not documented.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 4.

Life stages used to classify salmon: fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: Clear Creek RST annual reports do not state how life stage is determined.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, and more than once as conditions warrant.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a subsampling method when more than 250 salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 250.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? twice weekly.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 6 - 10%.

Description of trap efficiency tests: staff attempt to mark at least 400 salmon during each efficiency test. The goal during each trap efficiency test is to recapture at least 7 of the marked salmon that were released. The techniques used to mark salmon has varied over time. The process where trap efficiency tests were used to develop production estimates has varied substantially over time (see page 13 of the 2001 - 2002 RST report as an example). Changes in these processes should be analyzed to determine if these changes affect production estimates.

Trap efficiency notes: the salmon that are used during trap efficiency tests are marked using two methods. They are marked with Bismark brown stain, and then a portion of the upper or lower caudal fin is clipped.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped are used to estimate catch.

Are half-cone modifications used at the trap location? yes, but not on every day during a field season.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 90 and 95% confidence intervals are presented in annual RST reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) The upper Clear Creek RST trap was first installed in 2003.
- 2) Half cone operations are sometimes used at this RST trapping location. When this operation is used, 1/2 of the mouth of the RST is blocked, and the number of fish captured by the RST is reduced. This practice is used to reduce the number of spring-run Chinook salmon that are captured.
- 3) A picket weir was installed in Clear Creek in some, but not all, years when rotary screw trap operations were taking place in Clear Creek. The weir has been installed to prevent fall-run Chinook salmon from accessing areas where spring-run Chinook salmon could spawn. The installation of the weir may have reduced the amount of redd superimposition, and thereby affected the number of spring-run Chinook salmon produced by the creek. An analysis that evaluates the effects of the weir installation should be conducted before trends in salmon numbers are assessed. The weir's location has changed over time and this may have affected the production estimates of different runs of Chinook salmon.
- 4) Juvenile salmon are classified according to life stage but the methods for assigning a life stage are not described in RST reports.
- 5) The upper Clear Creek RST primarily captures spring-run Chinook salmon. On rare occasions, e.g., when high flows affect the above-mentioned weir, a limited number of fall-run Chinook salmon may also be caught by the upper Clear Creek RST.
- 6) Water releases from Whiskeytown Dam above the RST trapping location can affect the number of juvenile salmon that are captured.

- 7) Subsampling is used to estimate the daily catch when more than 250 juvenile salmon are caught. This can create an overestimation of the number of fish caught. One of the Clear Creek RST reports mentions this at length.
- 8) The USFWS staff that operate the upper Clear Creek RST did not provide peer review comments on the data summary pertaining this trapping location. The summary in this CAMP reference was therefore based on narratives in a Clear Creek RST annual report.

BASIC SITE INFORMATION

Watershed: Cosumnes River.

Trap location: Folsom South Canal Crossing.

CAMP rotary screw trap number: 7.

River mile at trap location: 23.

UTM NAD83 zone 10 easting: 656093.

UTM NAD83 zone 10 northing: 4257504

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: none.

Phone number: none.

Email: none.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 1999.

Year trapping started: 1999.

Normal start of field season: April.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data:

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 0.

Life stages used to classify salmon: salmon were not classified according to life stage.

Method used to classify immature salmon according to life stage: the single RST report available for this site makes reference to smolt size salmon > 70 mm in fork length. The report does not explicitly state that captured salmon were classified according to life stage.

Is there an effort to operate traps 7 days/week? no.

Are traps raised when they are not being serviced? not documented.

How many times a day is the trap serviced? unknown.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: all of the captured salmon were measured for length.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? not documented.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests were not done on the Cosumnes River.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon were not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? no.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? not applicable.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) The CAMP only has one RST report from the Cosumnes River, i.e., for 1999.
- 2) The trapping season in 1999 was short, i.e., from April to June.
- 3) The RST report states that "Data recorded during each servicing included number of hours fished since the last service".
- 4) The report makes no mention of how successfully or not the trap operations were on a day to day basis.
- 5) Trap efficiency tests were not done so the one available report only provides a tally of the number of Chinook salmon caught when the RST was operational.
- 6) Chinook salmon were not classified according to life stage as they were caught.
- 7) The 1999 RST report provides very little information as to how trapping was done at this site.

BASIC SITE INFORMATION

Watershed: Deer Creek.

Trap location: Deer Creek near Sacramento River confluence.

CAMP rotary screw trap number: 10.

River mile at trap location: 6.8.

UTM NAD83 zone 10 easting: 588704.

UTM NAD83 zone 10 northing: 4429491.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Colleen Harvey Arrison.

Phone number: (530) 527-9490.

Email: charvey@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall- and spring-run

Data for the following years is presented in an annual report: brood years 1993, 1994, 1995, 1996, 1997, 1998.

Year trapping started: 1994.

Normal start of field season: October.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: annual reports do not discriminate between runs, i.e., they only report the total number of Chinook salmon captured.

Number of life stages monitored: 2.

Life stages used to classify salmon: young of the year, yearling.

Method used to classify immature salmon according to life stage: assignment of life stage uses a combination of fish length and morphology.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

Deer Creek near Sacramento River confluence

The length of how many salmon are usually measured each day: 100.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests have not been conducted in Deer Creek.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon are not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? no.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? not applicable.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) The purpose of using a RST for outmigrant monitoring in Deer Creek is to avoid or minimize the effects of the State Water Project and Central Valley Project facilities operations on juvenile spring-run Chinook salmon as they move through the Sacramento - San Joaquin River Delta. Once flows or turbidity increase in Deer Creek or Chinook outmigrants are detected, water management operations in the Delta are modified to increase survival of these outmigrants. These modifications may include closing the Delta Cross Channel and/or modifying the State Water Project/Central Valley Project export pumping. To support water management activities in the Delta, the CDFG collects the following information: presence/absence, relative size (length), life-stage (yearling or not a yearling), relative abundance, and monitoring of increases in stream discharge and turbidity.
- 2) The data collection methods are not completely described in the annual Deer Creek RST reports.
- 3) The beginning and ending months in a particular trapping season vary depending on stream discharge and water temperature. In some years, the start of the trapping season is postponed due to low flows that prevent successful trap operation, and trapping may be terminated earlier in a season if water temperatures adversely affect juvenile salmon.
- 4) The months that were trapped each year have varied to a great degree. In some years trapping may have occurred for 8 months, and in other years trapping occurred in as few as 4 months.
- 5) Trapping activities in 1993 were not as intense as in following years because the trapping methods in the watershed were still being developed.
- 6) High discharge events can adversely affect trapping activities such that several days can pass when the trap is not in operation.
- 7) An assessment of annual changes in the relative abundance of juvenile salmon has not been conducted.
- 8) There has been no attempt to conduct trap efficiency tests at this location.
- 9) Fall- and spring-run Chinook salmon occur in the Deer Creek watershed. The trap location is downstream of where fall-run Chinook salmon spawn. Therefore, the trap captures both runs. Because fall- and spring-run Chinook salmon fry emerge at the same time, it is not possible to accurately distinguish between the two salmon runs.

- 10) After 1999, annual RST reports for Deer Creek were not prepared. Trapping has occurred every year since then, however.
- 11) When the number of captured salmon is sufficient, the lengths of 50 young-of-the-year salmon and 50 yearling salmon are measured each day.

BASIC SITE INFORMATION

Watershed: Feather River.

Trap location: High Flow Channel - Sunset Pumps.

CAMP rotary screw trap number: 12.

River mile at trap location: 38.

UTM NAD83 zone 10 easting: 617661.

UTM NAD83 zone 10 northing: 4345064.

Entity that does the trapping at the trap location: California Department of Water Resources.

Point of contact: Jason Kindopp.

Phone number: (530) 534-2381.

Email: jkindopp@water.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 1998 - 2001, 2001 - 2004, 2005 – 2007.

Year trapping started: 1996.

Normal start of field season: December.

Normal end of field season: June.

Has the sampling always taken place at the same location: no.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, intermediate, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a water displacement method when large numbers of salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? it is not uncommon to do 12 efficiency tests per year.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: eighty-eight trap efficiency tests in the Feather River watershed were conducted during the 2001 - 2004 time period. Trap efficiency tests were conducted using salmon captured in their respective traps (i.e. salmon trapped in the low flow channel were generally used for the low flow trap efficiency evaluations). Evaluations were performed between mid-December and mid-March, the period when nearly all emigration occurred. For each evaluation, approximately 1,000 marked salmon were transported roughly two kilometers upstream of each RST. All salmon were marked with bismarck brown dye. Recapture rates in the high flow channel ranged from 0 to 14.3% and averaged 4.02% (± 2.92 SD) over the same period.

Trap efficiency notes: one to two trap efficiency tests are done each week if sufficient numbers of Chinook salmon can be caught.

When more than one trap efficiency test is done in a week, one of the test groups is marked with elastomer dye.

Field staff look for a given release group for about one week after they are released.

Efficiency values were only applied to data for their respective year and location. Although efficiency tests were performed separately each week, two adjoining weeks of efficiency values were averaged to calculate daily trap efficiency and daily

emigration past each trap for the respective time period. This was done to avoid bias associated with few recaptures (see page 7; Roper and Scarnecchia, 1999). For weeks between 1 December and 15 April without efficiency tests, the average efficiency value for the year was used to calculate daily passage. Efficiency values were only applied to RST catch between December 1 and April 15.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped are used to estimate catch.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 95% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) The upstream-most limit of Chinook salmon in the Feather River is the Fish Barrier Dam near the Feather River Fish Hatchery. See Figure 2 in the 1998 - 2001 Feather River RST report. Above that structure, some of the water coming from Lake Oroville is diverted into the Thermolito Forebay and AfterBay. The channel below the Fish Barrier Dam and above the point where water from the Afterbay re-enters the Feather River channel is commonly called the Low Flow Channel. Downstream of the point where water from the Afterbay re-enters the Feather River channel, the channel is commonly called the High Flow Channel. River volume in the Low and High Flow channels is probably subject to continual modification due to water operations involving the Oroville Dam and the Thermolito Diversion Dam just upstream of the Fish Barrier Dam.

- 2) The trapping location in the High Flow Channel has changed over time. Between and including 1998 and 2001, trapping in the High Flow Channel occurred at Live Oak at river mile 42. Between and including 2001 and 2008, trapping in the High Flow Channel occurred at Herringer at river mile 46. Between and including 2007, 2008, and 2009, RST trapping in the High Flow channel occurred at a location commonly called "Sunset Pumps", i.e., at river mile 38.
- 3) There may be a need to assess, on an annual or monthly basis, how water diversion activities affect the number of juvenile Chinook salmon caught in the High Flow Channel. Water diversion activities during the RST trapping season should not be an issue, however (Jason Kindopp, CDWR, pers. comm.).
- 4) When large numbers of Chinook salmon have been caught, a water displacement method is used to estimate the number of captured salmon.
- 5) Some of the juvenile Feather River Chinook salmon have been tagged with a coded wire tag (CWT). A CWT detector is used to identify Chinook salmon that were previously marked.
- 6) Trap efficiency values may be pooled across weeks or years. See page 7 of 1998 - 2001 Feather River RST report for an example.
- 7) A few late fall-run Chinook salmon are caught in the Feather River rotary screw traps.
- 8) The process for marking juvenile salmon used in trap efficiency tests has changed over time and this change may have affected trap efficiency estimates. See page 16 of 1998 - 2001 Feather River RST report and pages 25 - 26 of the 2005 - 2007 RST report for examples. The process of conducting trap efficiency tests has been relatively consistent for the past 10 years, however.
- 9) The number of traps used in the High Flow Channel changed over time. One trap was used between 1998 and 2001, and two traps were used between 2004 and 2009.
- 10) The life stage classification scheme has changed over time. The 1998 - 2001 Feather River RST report refers to parr, intermediate, and smolts categories. The 2001 - 2004 RST report refers to sac fry, fry, parr, intermediate, and smolt categories.

- 11) Production estimates are inherently low for the reasons explained on page 7 of 2001 - 2004 Feather River RST report.
- 12) For periods when traps were used for less than seven consecutive days, the daily catch for the un-sampled period was estimated using a formula described in the 2001 - 2004 Feather River RST report.
- 13) A fish hatchery is present in this Feather River watershed. To accurately monitor the production of wild juvenile fall-run Chinook salmon, there needs to be a way to discriminate between wild and hatchery juvenile Chinook salmon. If this can not be done, it will be difficult to accurately quantify the number of wild juvenile fall-run Chinook salmon produced.

BASIC SITE INFORMATION

Watershed: Feather River.

Trap location: Low Flow Channel - Steep Riffle.

CAMP rotary screw trap number: 13.

River mile at trap location: 61.

UTM NAD83 zone 10 easting: 620089.

UTM NAD83 zone 10 northing: 4368987.

Entity that does the trapping at the trap location: California Department of Water Resources.

Point of contact: Jason Kindopp.

Phone number: (530) 534-2381.

Email: jkindopp@water.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, and spring-run.

Data for the following years is presented in an annual report: 1998 - 2001, 2001 -2004, 2005 – 2007.

Year trapping started: 1996.

Normal start of field season: December.

Normal end of field season: June.

Has the sampling always taken place at the same location: no.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, intermediate, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a water displacement method when large numbers of salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? several times per year.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: eighty-eight trap efficiency tests in the Feather River watershed were conducted during the 2001 - 2004 time period. Trap efficiency tests were conducted using salmon captured in their respective traps (i.e. salmon trapped in the low flow channel were generally used for the low flow trap efficiency evaluations). Evaluations were performed between mid-December and mid-March, the period when nearly all emigration occurred. For each evaluation, approximately 1,000 marked salmon were transported roughly two kilometers upstream of each RST. All salmon were marked with bismarck brown dye. Recapture rates in the low flow channel ranged from 0.6 to 13.5% and averaged 3.63% (± 2.43 SD) over the same period.

Trap efficiency notes: one to two trap efficiency tests are done each week if sufficient numbers of Chinook salmon can be caught.

When more than one trap efficiency test is done in a week, one of the test groups is marked with elastomer dye.

Field staff look for a given release group for about one week after they are released.

Efficiency values are only applied to data for their respective year and location. Although efficiency tests are performed separately each week, two adjoining weeks of efficiency values are averaged to calculate daily trap efficiency and daily emigration past each trap for the respective time period. This is done to avoid bias associated with few recaptures (see page 7; Roper and Scarnecchia, 1999). For weeks between 1 December and 15 April without efficiency tests, the average efficiency

value for the year is used to calculate daily passage. Efficiency values are only applied to RST catch between December 1 and April 15.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped is used to estimate catch.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 95% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) The upstream-most limit of Chinook salmon in the Feather River is the Fish Barrier Dam near the Feather River Fish Hatchery. See Figure 2 in the 1998 - 2001 Feather River RST report. Above that structure, some of the water coming from Lake Oroville is diverted into the Thermolito Forebay and AfterBay. The channel below the Fish Barrier Dam and above the point where water from the Afterbay re-enters the Feather River channel is commonly called the Low Flow Channel. Downstream of the point where water from the Afterbay re-enters the Feather River channel, the channel is commonly called the High Flow Channel. River volume in the Low and High Flow channels is probably subject to continual modification due to water operations involving the Oroville Dam and the Thermolito Diversion Dam just upstream of the Fish Barrier Dam.
- 2) The trapping location in the Low Flow Channel has changed over time. Between and including 1998 and 2006, trapping in the Low Flow Channel occurred at river mile 60.1 at a site known as Eye Riffle or Thermolito. Between and including 2006, 2007, 2008, and 2009, the RST trapping location occurred at a site known as Steep Riffle (river mile 61).

- 3) There may be a need to assess, on an annual or monthly basis, how water diversion activities affect the number of juvenile Chinook salmon caught in the Low and High Flow Channels. Water diversion activities during the RST trapping season should not be an issue, however (Jason Kindopp, CDWR, pers. comm.).
- 4) When large numbers of Chinook salmon are caught, a water displacement method is used to estimate the number of captured salmon.
- 5) Some of the juvenile Feather River Chinook salmon have been tagged with a coded wire tag (CWT). A CWT detector is used to identify Chinook salmon that were previously marked.
- 6) Trap efficiency values may be pooled across weeks or years. See page 7 of 1998 - 2001 RST report for example.
- 7) A few late fall-run Chinook salmon are caught in the Feather River rotary screw traps.
- 8) The process for marking juvenile salmon used in trap efficiency tests has changed over time and this change may have affected trap efficiency estimates. See page 16 of 1998 - 2001 Feather River RST report and pages 25 -26 of the 2005 - 2007 RST report for examples. The process of conducting trap efficiency tests has been relatively consistent for the past 10 years, however.
- 9) The number of traps used in the High Flow Channel changed over time. One trap was used between 1998 and 2001, and two traps were used between 2004 and 2009.
- 10) The life stage classification scheme change over time. The 1998 - 2001 Feather River RST report refers to parr, intermediate, and smolts categories. The 2001 - 2004 RST report refers to sac fry, fry, parr, intermediate, and smolt categories.
- 11) Production estimates are inherently low for the reasons explained on page 7 of 2001-2004 report.
- 12) For periods when the trap was set for less than seven consecutive days, daily catch for the un-sampled period was estimated using a formula described in the 2001 - 2004 Feather River RST report.

- 13) A fish hatchery does exist in this watershed. To accurately monitor the production of wild juvenile fall-run Chinook salmon, there needs to be a way to discriminate between wild and hatchery juvenile Chinook salmon. If this can not be done, it will be difficult to accurately quantify the number of wild juvenile fall-run Chinook salmon produced.

BASIC SITE INFORMATION

Watershed: Merced River.

Trap location: Hagaman State Park.

CAMP rotary screw trap number: 26.

River mile at trap location: 12.

UTM NAD83 zone 10 easting: 690448.

UTM NAD83 zone 10 northing: 4137561.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Tim Heyne.

Phone number: (209) 853-2533.

Email: theyne@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: none.

Year trapping started: 1998.

Normal start of field season: January.

Normal end of field season: May.

Has the sampling always taken place at the same location: not documented.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing:

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data:

SAMPLING GEAR

Number of traps at the trap location: usually 1.

Trap diameter (feet): not documented.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 0.

Life stages used to classify salmon: not documented.

Method used to classify immature salmon according to life stage: not documented.

Is there an effort to operate traps 7 days/week? not documented.

Are traps raised when they are not being serviced? not documented.

How many times a day is the trap serviced? not documented.

Daily catches quantified by counting: not documented.

Is the salmon length based on a fork or total length? not documented.

The length of how many salmon are usually measured each day: not documented.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? not documented.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? not documented.

How often are efficiency tests done? not documented.

Which kind of salmon are used to conduct the efficiency tests? not documented.

Are 200+ salmon used for each efficiency test? not documented.

Are trap efficiencies pooled across years? not documented.

The trap efficiency typically is between: not documented.

Description of trap efficiency tests: not documented.

Trap efficiency notes: there are no publically available reports explaining if and how trap efficiency tests were done.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? not documented.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? not documented.

Is flow/volume used to determine the total number of salmon caught? not documented.

What confidence intervals are placed on production estimates? not documented.

Are captures based on partial day operations expanded to 24 hours? not documented.

Are the formulas used to develop production estimates reported? not documented.

Are the formulas used to develop variance and confidence intervals reported? not documented.

Miscellaneous notes:

- 1) The California Department of Fish and Game operated one or more rotary screw traps at Hagaman State Park between 1998 and 2002.
- 2) Documentation that describes how trapping activities were done at this site is not publically available.
- 3) Raw catch data for the RST trapping location at Hagaman State Park are available on the Bay Delta and Tributaries (BDAT) website (http://www.bdat.ca.gov/Php/Data_Retrieval/data_retrieval_by_category.php). The raw RST catch data on this website suggests one RST was operated at this location during the following time frames: March - June 1998; January - May 1999; January - May 2000; January - June 2001; and February - May 2002.
- 4) The Universal Transverse Mercator coordinates for this location are a rough approximation based on the boundary of Hagaman State Park.
- 5) The river mile for this trap site is based on a one-line statement in the 2007 Cramer Fish Sciences RST annual report which states that the trapping at Hatfield State Park took place at river kilometer 19.3.
- 6) The similarity in location names for RST trapping locations on the lower Merced River (Hagaman State Park and Hatfield State Park) can be confusing.

BASIC SITE INFORMATION

Watershed: Merced River.

Trap location: Hatfield State Park.

CAMP rotary screw trap number: 14.

River mile at trap location: 2.

UTM NAD83 zone 10 easting: 680643.

UTM NAD83 zone 10 northing: 4136134.

Entity that does the trapping at the trap location: Cramer Fish Sciences.

Point of contact: Clark Watry.

Phone number: (209) 847-7786.

Email: clarkw@fishsciences.net.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 2007, 2008, 2009.

Year trapping started: 2007.

Normal start of field season: March.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): variable, depending on the field season.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? not always.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 25.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? ~5 times per field season.

Which kind of salmon are used to conduct the efficiency tests? hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? yes.

The trap efficiency typically is between: 0 - 2%.

Description of trap efficiency tests: seven efficiency tests with juvenile Chinook salmon from the Merced River Hatchery were done in 2008. Hatchery smolts were used as a surrogate during the time period when natural smolts were passing the trap. Releases consisted of approximately 1,000 salmon each and were conducted between 17 March and 15 May 2008. Salmon were dye-marked using a photonic marking gun.

Trap efficiency notes: it may be possible that the RSTs were not spinning the entire time trap efficiency test salmon were being recaptured, thereby biasing the trap efficiency test results.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped were used to estimate catch.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? yes.

What confidence intervals are placed on production estimates? 95% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) Trapping at this location using a RST was last done in 2009.
- 2) In 2007, two 8-foot diameter traps were used. In 2008, a 5- and 8-foot diameter trap were used at the site. In 2009, one 8-foot diameter trap were used.
- 3) In 2007, one of the traps not did rotate during half the days when sampling was attempted.
- 4) Trapping at this site (i.e., at river mile 2) has only been attempted between 2007 and 2009. CDFG did operate a RST at an adjoining location at Hagaman State Park (i.e., at river mile 12) from 1998 through 2002.
- 5) Smolt-size salmon were used during the 2007 efficiency tests, which may not reflect the capture probabilities of the fry-size salmon that were captured.
- 6) Only hatchery fish have been used for trap efficiency tests - these may not have the same capture probabilities as wild fish.
- 7) Very few fish have been caught at this location, e.g., in 2008, only 60 juvenile Chinook salmon were caught, and in 2009 11 juvenile salmon were caught.
- 8) The flow characteristics in this watershed are subject to conditions that result in poor trap operations - i.e., the trap does not spin due to low water velocity.
- 9) Production estimates are based on a trap efficiency - discharge relationship. Relatively few trap efficiency tests have been at this location.

- 10) A fish hatchery does exist in this watershed. To accurately monitor the production of wild juvenile Chinook salmon, there needs to be a way to discriminate between wild and hatchery juvenile Chinook salmon. If this can not be done, it will be difficult to accurately quantify the number of wild juvenile Chinook salmon produced.

BASIC SITE INFORMATION

Watershed: Merced River.

Trap location: Merced River near the town of Hopeton.

CAMP rotary screw trap number: 15.

River mile at trap location: 38.

UTM NAD83 zone 10 easting: 715190.

UTM NAD83 zone 10 northing: 4149865.

Entity that does the trapping at the trap location: Natural Resources Scientists, Inc.

Point of contact: Dave Vogel.

Phone number: (530) 527-9587.

Email: dvogel@resourcescientists.com.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: none.

Year trapping started: 1999.

Normal start of field season: January.

Normal end of field season: June.

Has the sampling always taken place at the same location: Yes, for the years 2000 through 2009. In 1999, trapping occurred near Hagaman Park in the lower Merced River.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 2.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 3.

Life stages used to classify salmon: fry, juvenile (intermediate), smolt.

Method used to classify immature salmon according to life stage: fork length.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? twice, more often when storms occur.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? 0 - several times per year.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: the fins of either wild or hatchery salmon are marked with a colored dye. The marked salmon are then released approximately one mile upstream of the RSTs.

Trap efficiency notes: trap efficiency test results have not been reported.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? see note below.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? not documented.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? no.

Are the formulas used to develop variance and confidence intervals reported? no.

Miscellaneous notes:

- 1) A brief description of the sampling program at this location is provided on the following web site: <http://www.mercedid.org/salmon/index.html>. Additionally, the web site provides data on daily numbers of juvenile salmon captured. The website also provides daily maximum, average, and minimum fork lengths for captured salmon. Annual reports on *O. mykiss* captured are provided to the National Marine Fisheries Service. Trap data are provided on an annual basis to the California Department of Fish and Game.
- 2) Juvenile salmon production estimates for this location have not yet been developed.
- 3) A fish hatchery does exist in this watershed. Unless there is a way to discriminate between wild- and hatchery-origin juvenile salmon, it may be difficult to develop production estimates for wild juvenile Chinook salmon.
- 4) The ability to conduct trap efficiency tests is affected by the availability of wild and/or hatchery fish. In some years, no efficiency tests were done; in other years, several tests were done.
- 5) Trap efficiencies range between 1 and 10%, and they are affected by river discharge.
- 6) On days when the trap did not operate, the number of fish that would have been caught will be estimated based on the prior and preceding days when the trap did operate.
- 7) The amount of water sampled by the traps is estimated with a flow meter that is positioned in front of the traps.

BASIC SITE INFORMATION

Watershed: Mill Creek.

Trap location: Mill Creek near Sacramento River confluence.

CAMP rotary screw trap number: 11.

River mile at trap location: 5.7.

UTM NAD83 zone 10 easting: 582847.

UTM NAD83 zone 10 northing: 4434284.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Colleen Harvey Arrison.

Phone number: (530) 527-9490.

Email: charvey@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall- and spring-run.

Data for the following years is presented in an annual report: brood years 1993, 1994, 1995, 1996, 1997, 1998.

Year trapping started: 1994.

Normal start of field season: October.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 5.

DATA COLLECTION

How is salmon run determined: annual reports do not discriminate between runs, i.e., they only report the total number of Chinook salmon captured.

Number of life stages monitored: 2.

Life stages used to classify salmon: young of the year, yearling.

Method used to classify immature salmon according to life stage: assignment of life stage uses a combination of salmon length and morphology.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

Mill Creek near Sacramento River confluence

The length of how many salmon are usually measured each day: 100.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests have not been done in Mill Creek.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon are not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? no.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable

Miscellaneous notes:

- 1) The purpose of using a RST for outmigrant monitoring in Deer Creek is to avoid or minimize the effects of the State Water Project and Central Valley Project facilities operations on juvenile spring-run Chinook salmon as they move through the Sacramento - San Joaquin River Delta. Once flows or turbidity increase in Mill Creek or Chinook outmigrants are detected, water management operations in the Delta are modified to increase survival of these outmigrants. These modifications may include closing the Delta Cross Channel and/or modifying the State Water Project/Central Valley Project export pumping. To support water management activities in the Delta, the CDFG collects the following information: presence/absence, relative size (length), life-stage (yearling or not a yearling), relative abundance, and monitoring of increases in stream discharge and turbidity.
- 2) The data collection methods are not completely described in the annual Mill Creek RST reports.
- 3) The beginning and ending months in a particular trapping season vary depending on stream discharge and water temperature. In some years, the start of the trapping season is postponed due to low flows that prevent successful trap operation, and trapping may be terminated earlier in a season if water temperatures adversely affect juvenile salmon.
- 4) The months that were trapped each year have varied to a great degree. In some years trapping may have occurred for 8 months, and in other years trapping occurred in as few as 4 months.
- 5) Trapping activities in 1993 were not as intense as in following years because the trapping methods in the watershed were still being developed.
- 6) High discharge events can adversely affect trapping activities such that several days can pass when the trap is not in operation.
- 7) An assessment of annual changes in the relative abundance of juvenile salmon has not been conducted.
- 8) There has been no attempt to conduct trap efficiency tests at this location.
- 9) Fall- and spring-run Chinook salmon occur in the Mill Creek watershed. The trap location is downstream of where fall-run Chinook salmon spawn. Therefore, the trap captures both runs. Because fall- and spring-run Chinook salmon fry emerge at the same time, it is not possible to accurately distinguish between the two salmon runs.

- 10) After 1999, annual RST reports for Mill Creek were not prepared. Trapping has occurred every year since then, however.
- 11) When the number of captured salmon is sufficient, the lengths of 50 young-of-the-year salmon and 50 yearling salmon are measured each day.

BASIC SITE INFORMATION

Watershed: Mokelumne River.

Trap location: Woodbridge Irrigation District Dam.

CAMP rotary screw trap number: 16.

River mile at trap location: 39.

UTM NAD83 zone 10 easting: 649153.

UTM NAD83 zone 10 northing: 4224599.

Entity that does the trapping at the trap location: East Bay Municipal Utility District.

Point of contact: Robyn Bilski.

Phone number: (209) 333-2095 Ext. 236.

Email: rbilski@ebmud.com.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.

Year trapping started: 1993.

Normal start of field season: December.

Normal end of field season: June.

Has the sampling always taken place at the same location: no.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: primarily morphological features; sometimes salmon length is used to identify fry.

Is there an effort to operate traps 7 days/week? no.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? once, sometimes twice.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? they are done frequently, sometimes 10 - 20 times per year.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: because trapping at this site has been done over a long period of time, it will be necessary to document all the techniques that have been used to conduct trap efficiency tests.

As an example of the more recently used trap efficiency techniques, the following text is from the 2002 - 2003 Mokelumne River RST report: "Sixteen calibration tests for Chinook salmon captures were conducted at the Woodbridge Irrigation Diversion Dam (WIDD) spill release location, consisting of eight nighttime tests and eight daytime tests. Calibration fish (juvenile Chinook salmon produced at the Mokelumne River Fish Hatchery) were marked using caudal clips or a NewWest photonic tagging gun. Calibration salmon were marked and held overnight to assess mark retention and mortality. Salmon were held in live-cars in bay 9a of the lower ladder. Releases were conducted after the morning trap check for the am release (between 8:00 am and 10:00 am), and at full darkness for the pm release (between 6:00 pm and 9:00 pm). Salmon were released at the crest of the spill of Woodbridge Dam".

Trap efficiency notes: in most cases, the trap efficiency test conducted during a given week was used to expand the daily catch value to a daily production estimate.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped are used to estimate catch.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 95% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? not documented.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? no.

Miscellaneous notes:

- 1) A fish hatchery is located above the RST trapping location. To accurately monitor the production of wild juvenile Chinook salmon, there needs to be a way to discriminate between juvenile wild- and hatchery-origin Chinook salmon. If this can not be done, it will be difficult to accurately quantify the number of wild juvenile Chinook salmon produced in the watershed.
- 2) Traps are positioned below the Woodbridge Irrigation District Dam (WIDD). There is a need to assess the potential that predation below the dam affects the number of juvenile salmon caught in the traps.
- 3) The trap location below the WIDD has changed at least 3 times (see page 10 of the 2005 Mokelumne River RST annual report). There is a need to assess how the change in trap location may have affected the ability to collect comparable data. The trap has always been deployed within 0.5 miles of the WIDD, however.
- 4) The number of RSTs deployed below the WIDD has varied over time: 1 trap was deployed in some years, 2 in others.

- 5) In addition to the RSTs, an incline trap and bypass trap have also been used to count salmon going by the WIDD (see the 1997 RST annual report). Since 2009, all the salmon caught in the bypass trap were released below the Woodbridge RST to prevent counting the same salmon twice. The catch from the bypass trap is added to the RST estimate in the annual Mokelumne River RST reports.
- 6) Some of the salmon collected by the Mokelumne River rotary screw traps since 1992 have been marked with a coded wire tag.
- 7) A large number of trap efficiency tests have been done at this site. A substantial amount of effort to document how all these tests were conducted is necessary so the results can be applied in a consistent way to develop salmon production estimates.
- 8) There is a need to assess how dam operations may have affected RST operations.
- 9) In some years, hatchery-origin salmon were used to conduct trap efficiency tests; in other years, a combination of wild- and hatchery-origin salmon were used.
- 10) In some cases, trap efficiency values routinely exceeded 10%.
- 11) Text on page 29 of the 1997 - 1998 Mokelumne River RST annual report suggests how salmon numbers may change as flow at the WIDD changes.
- 12) The trap cones on the RSTs at the WIDD are typically raised on a Friday prior to the weekend, and the trap cones are then lowered Monday morning.
- 13) In addition to the RST at Woodbridge Dam (i.e., at river mile 39), a RST has also been deployed at river mile 53 or 54 in 1992, 2008, and 2009.
- 14) Steelhead are sometimes caught at this trapping location. The number of captured steelhead rarely affects trapping operations.

BASIC SITE INFORMATION

Watershed: Sacramento River.

Trap location: Balls Ferry.

CAMP rotary screw trap number: 27.

River mile at trap location: 278.

UTM NAD83 zone 10 easting: 567200.

UTM NAD83 zone 10 northing: 4476900.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Robert Titus.

Phone number: (916) 227-6390.

Email: rtitus@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, spring-, and winter-run.

Data for the following years is presented in an annual report: 1997, 1998, 1999, 2000.

Year trapping started: 1996.

Normal start of field season: October.

Normal end of field season: September.

Has the sampling always taken place at the same location: not documented.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data:

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): not documented

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 0.

Life stages used to classify salmon: salmon were not classified according to life stage.

Method used to classify immature salmon according to life stage: none.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? not documented.

How many times a day is the trap serviced? at least once.

Daily catches quantified by counting: not documented.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 300.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? not documented.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? weekly.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? usually, yes.

Are trap efficiencies pooled across years? not documented.

The trap efficiency typically is between: 0 - 2%.

Description of trap efficiency tests: the following quote was taken from the Balls Ferry RST annual report that provided results from the 1999 - 2000 trapping period. It is similar to text from other Balls Ferry RST annual reports. "Trap efficiency was evaluated by marking a portion of salmon captured (winter run were never marked). Salmon were marked with dyes either by injecting them with Alcian blue or, rarely, by bathing them in Bismark brown. Salmon captured and marked at Balls Ferry were transported upstream about 2,500 feet then released. All salmon captured in the Balls Ferry traps were checked for marks as they were measured."

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? not documented.

Are half-cone modifications used at the trap location? not documented.

Are there efforts to highlight periods of bad trap operation? no.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? not documented.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) Trapping with an RST at Balls Ferry may not have taken place after 2000.
- 2) The available Balls Ferry RST annual reports do not provide an in-depth description of how data were collected. The data provided in the reports appear to provide summaries for catch and trap efficiencies, and when salmon were caught, but beyond this, there is little other information in the reports.
- 3) A system for classifying salmon according to life stage was not described in the Balls Ferry RST annual reports. At least one annual report referred to "recently emerged size fish (<35 mm FL) and larger smolt size fish (>70 mm FL)", thereby suggesting that size could be used to classify salmon according to life stage.
- 4) Sampling was dramatically reduced in intensity at times to reduce the catch of listed winter-run Chinook salmon.
- 5) All of the captured salmon were examined for marks.
- 6) Some of the captured salmon were weighted.

BASIC SITE INFORMATION

Watershed: Sacramento River.

Trap location: Glenn Colusa Irrigation Diversion.

CAMP rotary screw trap number: 25.

River mile at trap location: 205.5.

UTM NAD83 zone 10 easting: 581483.

UTM NAD83 zone 10 northing: 4404848.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Diane Coulon.

Phone number: (530) 895-5002.

Email: dcoulon@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, spring-, and winter-run.

Data for the following years is presented in an annual report: 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.

Year trapping started: 1991.

Normal start of field season: January.

Normal end of field season: December.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production:

Assess relative juvenile salmon abundance: ✓

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 0.

Life stages used to classify salmon: salmon were not classified according to life stage.

Method used to classify immature salmon according to life stage: none.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once.

Daily catches quantified by counting: individual salmon in most instances, and using a water displacement method when large numbers of salmon were present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? no.

How often are efficiency tests done? not applicable.

Which kind of salmon are used to conduct the efficiency tests? not applicable.

Are 200+ salmon used for each efficiency test? not applicable.

Are trap efficiencies pooled across years? not applicable.

The trap efficiency typically is between: not applicable.

Description of trap efficiency tests: trap efficiency tests were not done at the Glenn Colusa Irrigation Diversion.

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon are not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? not applicable.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? not applicable.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) Trap efficiency tests were not done at the Glenn Colusa Irrigation Diversion.
- 2) The primary reason for collecting the RST data at this trapping location was to assess trends in the number and presence of different runs of threatened and endangered Chinook salmon.
- 3) 50 juvenile salmon of each run were measured for length each day.
- 4) Operation of the RST at the Glenn Colusa Irrigation Diversion was terminated in 2008.

BASIC SITE INFORMATION

Watershed: Sacramento River.

Trap location: Knights Landing.

CAMP rotary screw trap number: 17.

River mile at trap location: 88.5.

UTM NAD83 zone 10 easting: 612991.

UTM NAD83 zone 10 northing: 4295639.

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Robert Vincik.

Phone number: (916) 358-2933.

Email: rvincik@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, spring-, and winter-run.

Data for the following years is presented in an annual report: 1996, 1997, 1998, 1999, 2000.

Year trapping started: 1995.

Normal start of field season: October.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): variable, depending on the field season.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? no.

How many times a day is the trap serviced? once, sometimes twice.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 150.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? 5 - 10 times per season, depending on the number of salmon caught.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 0 - 2%.

Description of trap efficiency tests: the following text from the 1999 - 2000 Knights Landing RST report is consistent with the way trap efficiency tests have been done at the site: "Trap efficiency was evaluated using a mark-recapture technique. All trapped Chinook salmon (except winter-run sized Chinook) were marked using a Bismark Brown Y stain then released about 0.5 miles upstream of the traps. Our objective was to mark and release at least 100 salmon per trial. When <100 salmon were collected in a day, salmon were held until greater than 100 salmon were available for marking, or up to 3 days maximum, whichever occurred first. Efficiency was calculated as the percentage of marked salmon that were recaptured in the traps on a weekly basis. The mean trap efficiency in 1999 - 2000 was 0.25%."

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon are not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? 80% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? no.

Are the formulas used to develop variance and confidence intervals reported? no.

Miscellaneous notes:

- 1) The Coleman National Fish Hatchery (CNFH) is upstream of this trap site. Large numbers (1 million+) of unmarked fall-run Chinook salmon are released into the Sacramento River and swim past this trap site. There is a limited ability to identify these hatchery salmon. If the initial date that hatchery-reared salmon were released is known, it could be assumed that all juvenile salmon caught prior to this date were wild salmon.
- 2) The Knights Landing RST should have the ability to identify wild spring-, late fall-, and winter-run Chinook salmon because all of the hatchery salmon pertaining to these runs were marked.
- 3) When water enters the Sutter Bypass upstream of this trap, some of the migrating juvenile salmon coming down the Sacramento River are diverted into the bypass and therefore were not caught at Knights Landing. When this situation occurs, the Knights Landing traps were only capturing a subsample of the juvenile salmon moving downstream through the Sacramento River.
- 4) A 5-foot diameter trap has infrequently been used at Knights Landing; two 8-foot diameter RSTs are usually used at this site. Since 2000, only 8-foot diameter traps have been used.
- 5) Trap efficiency tests use a relatively small number of salmon compared to the total trap captures. Trap efficiencies at this site are usually below 2%.
- 6) The methods for collecting salmon are not described in great detail in the annual reports.
- 7) CDFG may manually adjust the run classification of some salmon instead of relying on the length at date criteria to identify run (see page 9 of the 1999 - 2000 Knights Landing RST report). This results in some salmon being reclassified from spring-run Chinook salmon to fall-run Chinook salmon.

- 8) Because large numbers of salmon are captured at this site, there may be problems in regard to accurately detecting marks on all the captured salmon or accurately quantifying the percentage of salmon that have marks.
- 9) If more than one run is captured, up to 150 individuals for each run may be measured according to length.
- 10) There are several tributary watersheds upstream of the Knights Landing capture site. Many biologists working in those tributaries mark their salmon, and these salmon may later be caught at Knights Landing. It will require substantial effort to understand which salmon were marked by the Knights Landing RST staff during a trap efficiency test, and which salmon were marked by other biologists not working at this site. The challenge of understanding which marks apply to the trap efficiency tests conducted by the Knights Landing staff may complicate the ability to accurately assess the Knights Landing RST trap efficiencies.

BASIC SITE INFORMATION

Watershed: Sacramento River.

Trap location: Red Bluff Diversion Dam.

CAMP rotary screw trap number: 18.

River mile at trap location: 243.

UTM NAD83 zone 10 easting: 567950.

UTM NAD83 zone 10 northing: 4445040.

Entity that does the trapping at the trap location: U.S. Fish and Wildlife Service.

Point of contact: Bill Poytress.

Phone number: (530) 527-3043 Ext. 231.

Email: bill_poytress@fws.gov.

Chinook salmon runs present in the watershed: fall-, late fall-, spring-, and winter-run.

Data for the following years is presented in an annual report: 1995 - 2000 (all 4 salmon runs); 2002, 2003, 2004, 2005, 2006 (winter-run only).

Year trapping started: 1994.

Normal start of field season: January.

Normal end of field season: December.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? yes.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 4.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 2.

Life stages used to classify salmon: fry, pre-smolt/smolt.

Method used to classify immature salmon according to life stage: salmon less than 46 mm in length are classified as fry, and salmon more than 45 mm in length are classified as presmolt/smolts.

Is there an effort to operate traps 7 days/week? yes. When high-flow events and periods of high winter-run salmon abundance occur, trapping may not be done 7 days per week.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, some times more.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 100.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? 5 - 20 times each year.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? yes.

The trap efficiency typically is between: 0 - 2%.

Description of trap efficiency tests: salmon are marked with bismark brown stain. The salmon are then held for 6 - 24 hours before release. The marked salmon are released 4 kilometers upstream of the Red Bluff Diversion Dam. Trap efficiency is calculated based on the proportion of recaptures to total salmon released.

Trap efficiency notes: a regression equation is used to estimate trap efficiency. The variables in the regression equation are the estimated percentage of the daily river volume sampled by the 4 RSTs vs. the observed trap efficiencies based on trap efficiency tests for all years when trap efficiency tests were done. The resulting regression is then used to predict daily trap efficiencies on days when trap efficiency tests are not done but when the sampled river volume is known. These estimated trap efficiencies are then used to develop daily production estimates.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? see comments in miscellaneous notes section below.

Are half-cone modifications used at the trap location? yes, but not on every day during a field season.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? yes.

What confidence intervals are placed on production estimates? 90% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? yes.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) Reports that provide production estimates for all four runs of Chinook salmon are available for the 1994 - 2000 time period. Reports that provide data for winter-run Chinook salmon have been prepared for brood years 2002, 2003, 2004, 2005 and 2006. The http://bdat.ca.gov/Php/Special_Reports/red_bluff.php website has 14-day tabular summary reports for all four Chinook salmon runs during the 2004 - 2008 time period.
- 2) The presence of listed species (e.g., winter-run Chinook salmon) affects trap operations. When these salmon are present the following changes to sampling can occur: half-cone operations are used, fewer traps can be used, a subset of the day (e.g., 6 hours) can be used to develop an estimate of the number of salmon that would have been caught in a 24-hour period, or traps may be operated less than 7 days each week.
- 3) Half cone operations refer to the practice of placing a metal cover over 1 of the 2 intakes of the rotating RST cone while a portion of the cone screen is removed to allow salmon and debris to be diverted away from the RST live box. This practice presumably reduces the capture of juvenile salmon to 1/2 the number of individuals that would have been caught had the cover not been in place (See Gaines and Poytress 2004). The practice of using half cone modifications only occur when daily catches are in excess of 200 or more salmon per day (and typically more like 400 - 500+ salmon). It has been noted that modification of traps when catch is low (<100 salmon/day) can have dramatic effects on fish capture and subsequent passage estimates. There is a lower limit (not absolutely defined yet) as to when cone modification will result in significant differences in catch rates.
- 4) Length at date criteria are used to determine salmon run. In some cases, the number of individuals in some runs can be over-estimated, while the number of individuals in other runs can be underestimated.

- 5) Changes in Red Bluff Diversion Dam operations can affect flow characteristics and water depths below the dam, causing a need to move the traps upstream or downstream of the dam. The traps are also moved laterally across the dam face at times.
- 6) Subsampling procedures can result in the capture of a few salmon being extrapolated into relatively large numbers of salmon.
- 7) The trap efficiency typically is between 0 and 2%, the range is between 0.3 to 5.27%, the mean efficiency is = 1.89%, with a standard deviation = 0.8%.
- 8) Three to four RSTs at the Red Bluff Diversion Dam are usually used to estimate salmon production.
- 9) In regards to the number of salmon that are measured for length each day, the protocol for this location calls for the measurement of between 100 and 150 salmon per trap per day. All salmon are measured unless random subsampling occurs (catch/trap >200-300 Chinook) whereby the final measured group contains 100 - 150 salmon and the rest are enumerated.
- 10) On days when traps did not operate, the number of salmon that would have passed the trap is estimated by calculating the weekly mean of the week's passage data and imputing the values into the missing days. The result is a weekly passage estimate.
- 11) A complex database/software program is used to develop production estimates.
- 12) As data are collected, samples are designated for use in passage estimates if the trap was sampling properly and the contents of the live box are not compromised, e.g. a sunken trap with overflow out of live box is not used for estimating salmon production.
- 13) Salmon used in trap efficiency tests are released four kilometers upstream of the dam. The recovery rate of the marked salmon used during an efficiency test may be affected as predators consume the marked salmon.
- 14) The trap is located downstream of the Coleman National Fish Hatchery which releases large numbers of unmarked fall-run Chinook salmon. Many of the salmon captured at the RBDD could be hatchery-origin salmon and not wild-origin salmon; the production estimates for the number of wild fall-run Chinook salmon being produced may therefore be inflated due to the inability to discriminate between wild and hatchery-origin salmon.

BASIC SITE INFORMATION

Watershed: Stanislaus River.

Trap location: Caswell State Park.

CAMP rotary screw trap number: 19.

River mile at trap location: 9.

UTM NAD83 zone 10 easting: 660479.

UTM NAD83 zone 10 northing: 4174348.

Entity that does the trapping at the trap location: Cramer Fish Sciences.

Point of contact: Clark Watry.

Phone number: (209) 847-7786.

Email: clarkw@fishsciences.net.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009.

Year trapping started: 1994.

Normal start of field season: December.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 6.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolt, yearling.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes?

How many times a day is the trap serviced? once, some times more.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 25.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? at least 5 times each year.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? yes.

The trap efficiency typically is between: 6 - 10%.

Description of trap efficiency tests: given the long record of operation at the site, there is a need to look at documentation and determine if the methods for conducting trap efficiency tests has changed over time. In 2008, trap efficiency tests were done as follows: "We conducted seven efficiency tests with juvenile Chinook salmon from Merced River Hatchery. Due to low catch, sufficient natural smolts were unavailable; therefore, hatchery smolts were used as surrogates during the time period when natural smolts were passing the trap. Releases consisted of approximately 500 salmon each for the first six tests (14 April - 19 May 2008) and 1,333 salmon for the seventh and final test conducted on 27 May 2008. Salmon were dye-marked using a photonic marking gun (Meda-E- Jet; A1000) with pink dye on the caudal or anal fin or immersed in a Bismarck Brown Y (Sigma-Aldrich) solution resulting in a full body mark. Releases occurred approximately 430 m upstream of the traps from the north bank at a narrow (~ 20 m) and deep area of the river."

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? varies.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? yes.

What confidence intervals are placed on production estimates? 95% confidence intervals are always presented in the annual reports.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? yes.

Miscellaneous notes:

- 1) Given the long period of record of operations at this site, there should be an effort to document how data collection methods have changed over time because there have been changes.
- 2) Trap efficiency tests are pooled across years to develop a regression line that plots trap efficiency vs. instantaneous river discharge. This relationship is then used to estimate trap efficiency on a day with X discharge, which in turn is used to develop a production estimate.
- 3) The methods to classify fish according to life stage have changed over time. See page 100 of the 1999v2 Caswell RST report. Over the years, life stage classification has been based on morphology, the date fish were caught, and the date of capture.
- 4) Salmon captured at this location have been marked with a coded wire tag in some years.
- 5) See Appendix A of the 1999v2 Caswell RST report for an example of how data have been processed in different ways over time.
- 6) At least some of the trap efficiency tests used to develop a trap efficiency vs. stream discharge regression line are of questionable value. E.g., a trap efficiency may have been generated for a day when a RST was not fully functional.
- 7) With the exception of 2009, the trapping location at Caswell State Park has remained at the same location over time. In 2009, the trapping location was moved ~50 meters upstream and a single trap (as compared to the two RSTs that have always been used) was used due to low river discharge conditions.

- 8) Some of the trap efficiency tests may have used hatchery fish that were not comparable in size to the wild fish that were being caught.
- 9) In several years (e.g., 2003) "data reports" were prepared. These reports only provide raw data, i.e., there is no narrative explaining how trapping was done that year or what problems were encountered.
- 10) In some years, in-river structures (e.g. sand bags) were installed to direct more of the river volume into the RSTs.

BASIC SITE INFORMATION

Watershed: Stanislaus River.

Trap location: Stanislaus River near the town of Oakdale.

CAMP rotary screw trap number: 24.

River mile at trap location: 40.1.

UTM NAD83 zone 10 easting: 687801.

UTM NAD83 zone 10 northing: 4182546.

Entity that does the trapping at the trap location: FISHBIO Environmental, LLC.

Point of contact: Chrissy L. Sonke.

Phone number: (209) 614-0813.

Email: chrissysonke@fishbio.com

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 1993, 1995, 1996, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.

Year trapping started: 1993.

Normal start of field season: January.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 3.

Life stages re used to classify salmon: fry, parr, smolt.

Method used to classify immature salmon according to life stage: length is used to discriminate among the fry, parr, and smolt life stages. Salmon are also assigned a smolt index based on morphological features.

Is there an effort to operate traps 7 days/week? yes, if large numbers of salmon are caught.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, sometimes more often if conditions warrant such action.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? one to two times per week, depending on the availability of wild or hatchery salmon.

Which kind of salmon are used to conduct the efficiency tests? usually wild salmon; infrequently, hatchery salmon.

Are 200+ salmon used for each efficiency test? not always, but usually yes.

Are trap efficiencies pooled across years? see miscellaneous notes in Data Processing section.

The trap efficiency typically is between: 6 - 10%.

Description of trap efficiency tests: wild salmon are accumulated from trap catch over a period of up to a couple of days. Salmon are photonically marked at least 24 hours prior to release. All salmon are released approximately 0.5 miles upstream of the trap at night. The trap is processed immediately before release to ensure the trap is functioning properly. Approximately one hour after the salmon are released, the trap is processed again. The trap is then processed every hour after until only 1 - 2 salmon are recovered in from the live box. All salmon are checked for marks when the trap is processed the next morning. Almost all the marked salmon are recovered the night of the release and very few marked salmon are recovered the next morning.

Trap efficiency notes: occasionally, salmon were marked with two different types of marks and then released on the same day. These salmon were separated into two groups and released at different times. This process was used to test the variability of recapture rates under the same conditions. Hatchery groups were at times released the same night as wild salmon as well as mixing the wild and hatchery salmon into one large group.

Occasionally, salmon were marked with a coded wire tag (CWT) as part of a survival study in the watershed. Salmon tagged with a CWT were not used as part of a trap efficiency test.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? varies.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) The methods to classify salmon according to life stage have changed over time. See page 100 of the 1999v2 Oakdale RST report. Over the years, life stage classification has been based on morphology, the date salmon were caught, and the date of capture. Earlier reports classified salmon as follows: fry = <45 mm, parr = 46 - 79 mm, smolt = >79 mm. More recently, the classifications have changed to be more consistent with the trapping activities in the rest of the San Joaquin River Basin, i.e., fry = <50 mm, parr = 50 - 69 mm, smolt = >69 mm.
- 2) See Appendix A of the 1999v2 Oakdale RST report for an example of how data have been processed in different ways over time.
- 3) Some of the trap efficiency tests may have used hatchery salmon that were not comparable in size to the wild salmon that were being caught.
- 4) In several years (e.g., from 2004 on) RST "data reports" were prepared. These reports only provide raw data, i.e., there is no narrative explaining how trapping was done that year or what problems were encountered during a field season.

- 5) The trap is fished seven days per week when catch is high and catch and/or environmental conditions are variable. During the beginning of the season when catch is low, the trap may only be operated intermittently until catch increases or environmental conditions change. The trap is not fished on the weekends from Memorial Day weekend to the end of sampling because of safety concerns for recreational river users.
- 6) 50 Chinook are measured every morning. If an additional trap check is conducted, 20 Chinook are measured from the first additional check. Any subsequent checks enumerate salmon only.
- 7) Trap efficiencies are pooled across years only if efficiency tests were not conducted for specific life stages/flow conditions. If the tests are pooled, only certain years are used because the river channel may have changed during floods and drought years (i.e., the trap efficiency changed).
- 8) Trap efficiency is highly dependent on stream flow and life stage of fish. Also, channel morphology has changed significantly over the years, first with a 1997 flood and then again with several years of low river discharge. The trap efficiency was much lower following the 1997 flood because a significant portion of the flow went through a side channel on the south bank of the river. The channel began changing again after several years of low flows and trap efficiency increased since most of the flow began going through the main channel again. Trap efficiency is high for fry (20 - 40%), low for parr [$<10\%$], and in between for smolts [10 - 20%]. Trap efficiency is low (less than 5%) when flows are higher (greater than 750 cubic feet per second).
- 9) Catches have not been adjusted for temporary trap stoppages because they occur infrequently. The trap operated every day in 2007 and 2008. In 2006, the trap didn't operate every day when catch was consistently low in the early part of the season. If no sampling occurred on a given day, catch was estimated using the combined daily counts for up to five days prior to and immediately following the period of no sampling days. Salmon production estimates are developed using the following steps: (a) adding one to the combined counts of the five previous and five subsequent days, (b) taking the natural logs of the resulting values, (c) computing the weighted mean of those natural logs, and (d) re-transforming the resulting mean.
- 10) Abundance estimates were generated using a regression based on flow and trap efficiency results from 1996 through 1999. However, from 2000 to present abundance estimates have been solely based on trap efficiency because of lack of funding to pay for a statistician who could assist with the development of appropriate salmon estimation procedures.

BASIC SITE INFORMATION

Watershed: Tuolumne River.

Trap location: Grayson Ranch.

CAMP rotary screw trap number: 21.

River mile at trap location: 5.

UTM NAD83 zone 10 easting: 665375.

UTM NAD83 zone 10 northing: 4161526.

Entity that does the trapping at the trap location: California Department of Fish and Game / FISHBIO Environmental LLC.

Point of contact: Tim Heyne / Andrea Fuller.

Phone number: (209) 853-2533 / (209) 840-4845.

Email: theyne@dfg.ca.gov / andreafuller@fishbio.com.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 1999 - 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009.

Year trapping started: 1995.

Normal start of field season: January.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data:

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 5.

Life stages re used to classify salmon: yolk sac fry, fry, parr, smolt, yearling.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, sometimes twice.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? sometimes as often as 10+ times a year.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? yes.

The trap efficiency typically is between: 1 - 15%.

Description of trap efficiency tests: the following text is taken from the 2006 Grayson Ranch RST report and is representative of most (but perhaps not all) of the trap efficiency tests done at this location: Wild salmon are usually collected "over several days to have enough for a release group. If low capture rates prevented the use of natural salmon, hatchery-reared salmon were obtained from the Merced River Hatchery. All hatchery and natural groups were marked by dye inoculation using a photonic marking system. All marked salmon were released at dark from their respective release sites."

The 2006 RST report provides additional details describing the procedures used during trap efficiency tests.

Trap efficiency notes: trap efficiency results are highly variable. The 2008 Grayson Ranch RST report provides a table summarizing trap efficiency tests done at Grayson Ranch between 1999 and 2008.

Trap efficiency tests were frequently done with the goal of measuring trap efficiency in relation to different fish sizes (life stages). As such, the trap efficiency results are a data - rich source of information.

Because CDFG conducted the trapping activities at Grayson Ranch between 1999 and 2003 and FISHBIO staff conducted the trap efficiency tests at this site beginning in 2004, the methods for conducting trap efficiency tests may have changed over time.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the number of salmon on the days before and after trapping stopped are used to estimate catch.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? to some degree.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? no.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) There have been changes in the personnel who operated the traps at Grayson Ranch. Between 1999 and 2003, the California Department of Fish and Game operated the traps. After that year, FISHBIO staff operated the traps. It should not be assumed the sampling methods or data analysis procedures used by the two entities are identical.
- 2) The salmon used for trap efficiency tests are sometimes hatchery fish from another watershed.
- 3) Life stage is sometimes based on a subsample of fish, not all fish captured.
- 4) There was an effort, at least in some years, to account for the portion of a day when a trap did not operate successfully. See text in the 2003 Grayson Ranch RST report.
- 5) In 1998, only one RST was operated at this site.
- 6) The sampling periods have varied greatly between years. In some year monitoring began anywhere between January 3 and April 18, and ended anywhere between May 24 and July 1.

- 7) Some salmon life stages, e.g., sac fry and yearlings, may not have been collected each year.
- 8) The methods and data used to estimate trap efficiency have changed over time. Also, the model used to estimate trap efficiency has evolved as more trap efficiency test data were incorporated into the model, i.e., fish abundance estimates in one report may not be comparable with another report. To address this problem, FISHBIO staff have re-calculated all the post-1999 fish abundance estimates using one updated model and a consistent approach.
- 9) The fork, total, and standard lengths of some salmon have been measured by FISHBIO staff.

BASIC SITE INFORMATION

Watershed: Tuolumne River.

Trap location: Tuolumne River near the town of Waterford.

CAMP rotary screw trap number: 23.

River mile at trap location: 29.8.

UTM NAD83 zone 10 easting: 695334.

UTM NAD83 zone 10 northing: 4165978.

Entity that does the trapping at the trap location: FISHBIO Environmental, LLC.

Point of contact: Chrissy L. Sonke.

Phone number: (209) 614-0813.

Email: chrissysonke@fishbio.com.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 2006, 2007, 2008.

Year trapping started: 2006.

Normal start of field season: January.

Normal end of field season: June.

Has the sampling always taken place at the same location: no.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: always 1.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 3.

Life stages used to classify salmon: fry, parr, smolt.

Method used to classify immature salmon according to life stage: life stages are based on length where <50 mm = fry, 50 - 69 mm = parr, and > 70 mm = smolt.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once, and more often if salmon abundance or debris levels are high.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 50.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? 1- 2 times per week if adequate numbers of salmon are present.

Which kind of salmon are used to conduct the efficiency tests? wild and hatchery salmon.

Are 200+ salmon used for each efficiency test? not always.

Are trap efficiencies pooled across years? in most cases no.

The trap efficiency typically is between: 6 - 10%.

Description of trap efficiency tests: wild salmon are accumulated from trap catch over a period of up to a couple of days. Salmon are photonically marked at least 24 hours prior to release. All salmon are released approximately 0.2 miles upstream of the trap at night. The trap is processed immediately before release to ensure the trap is functioning properly. Approximately one hour after the fish are released, the trap is processed again. The trap is then processed every hour thereafter until only 1 - 2 salmon are recovered from the livebox. All salmon are checked for marks when the trap is processed the next morning. Almost all the marked salmon are recovered the night of the release and very few marked salmon are recovered the next morning.

Trap efficiency notes: there is an effort to conduct efficiency tests one to two times per week depending on wild salmon availability. Trap efficiency tests are conducted most weeks for the fry life stage, but less frequently for parr and smolt size salmon because of inadequate catch numbers or the inability to acquire hatchery salmon.

To the extent possible, wild salmon are used to conduct efficiency tests, but if catch of wild salmon is inadequate and hatchery salmon are available, then they are used. During the last few years, fish production at the Merced River Hatchery has been extremely low and salmon have not been available to use for trap efficiency tests.

Trap efficiency test are conducted with a minimum of 30 to 50 salmon, depending on their availability.

Trap efficiencies are pooled within the same year for salmon of similar size and during similar river discharges. If trap efficiency data is unavailable for a particular life stage and flow, then data from a past year may be used to estimate salmon production.

A mixture of wild and hatchery salmon can be used during a particular efficiency trial.

Photonic dye has been used to mark salmon because of its ability to provide a highly visible, long-lasting mark.

Trap efficiencies (TE) are typically 3 - 34% for fry, 4 - 6% for parr and 5 - 12% for smolt. TE at the trap location depends on life stage and flow. The higher the flow, the lower the TE. TE for fry size fish is normally higher than parr and smolt size fish. Trap efficiency is usually lowest for parr size salmon and smolt TE is somewhere in between the two other life stages.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? see the 2007 Waterford RST report.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? yes.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) Catches have not been adjusted for temporary trap stoppage since they happen infrequently. The trap was operated every day in 2007 and 2008. In 2006, the trap didn't operate every day when catch was consistently low in the early part of the season. If no sampling occurred on a given day, catch was estimated using the combined daily counts for up to five days prior to and immediately following the period of no sampling days. The methods used to estimate salmon production followed the following steps: (a) adding one to the combined counts of the five previous and five subsequent days, (b) taking the natural logs of the resulting values, (c) computing the weighted mean of those natural logs, and (d) re-transforming the resulting mean.
- 2) If the live box was full of debris, the screen on the live box is removed and trap catch for that period is estimated using the estimation procedures above.
- 3) Because trapping at the Waterford site has only occurred for a relatively short period of time (i.e., since 2006), there is insufficient trap efficiency data to develop a regression curve to develop fish production estimates. Salmon production estimates are developed by expanding the daily number of fish caught times the average observed trap efficiency for each life stage. A regression will be used to estimate salmon production after enough years of data are collected.

BASIC SITE INFORMATION

Watershed: Tuolumne River.

Trap location: Shiloh Bridge.

CAMP rotary screw trap number: 20.

River mile at trap location: 3.4.

UTM NAD83 zone 10 easting: 664900.

UTM NAD83 zone 10 northing: 4163400

Entity that does the trapping at the trap location: California Department of Fish and Game.

Point of contact: Tim Heyne.

Phone number: (209) 853-2533.

Email: theyne@dfg.ca.gov.

Chinook salmon runs present in the watershed: fall-run.

Data for the following years is presented in an annual report: 1995 -1996, 1997, 1998.

Year trapping started: 1995.

Normal start of field season: April.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance: ✓

Collect juvenile salmon life history data:

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 8.

DATA COLLECTION

How is salmon run determined: there is only one run in the watershed.

Number of life stages monitored: 0.

Life stages used to classify salmon: salmon were not classified according to life stage.

Method used to classify immature salmon according to life stage: salmon in 1995, 1996, and 1997 were apparently only considered to be smolts. In 1998, a smoltification index code was used to assigned salmon to different stages of smoltification.

Is there an effort to operate traps 7 days/week? no.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? usually more than once.

Daily catches quantified by counting: every salmon.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 100.

Do listed species affect the trapping operations? no.

Are trap revolutions monitored and reported? no.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? as many as 8 trap efficiency tests were done in one year.

Which kind of salmon are used to conduct the efficiency tests? hatchery salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 0 - 2%.

Description of trap efficiency tests: the salmon used in trap efficiency tests were always salmon from the Merced River Fish Hatchery, i.e., they were always hatchery salmon from another watershed. The salmon that were marked for trap efficiency tests received a colored dye mark. The marked salmon were released approximately 0.2 - 0.5 miles upstream of the RST. Efficiency tests were done ~ one time each week during the period when the RST(s) were operated. The methods for conducting trap efficiency tests in 1995, 1996, and 1997 are not described in detail. 1,000 - 2,000 salmon were marked for each trap efficiency test.

Trap efficiency notes: some of the marked salmon that were captured during trap efficiency tests may have been marked with a coded wire tag (CWT). The salmon with CWTs were not associated with the mark-recapture trap efficiency tests, but were instead associated with tests that were designed to assess the survival of salmon as they moved through the Tuolumne River.

Trap efficiencies tended to be very low, i.e., below one percent. This may have been a function of the large sizes of the salmon being used during trap efficiency tests (larger juveniles may be more difficult to re-capture than smaller juveniles).

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? catch data from the days fished in a week is expanded to a total catch for a 7-day week.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? no.

Is flow/volume used to determine the total number of salmon caught? yes.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? yes.

Are the formulas used to develop production estimates reported? yes.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) The reason for operating RST(s) at Shiloh Bridge changed in a marked way over time. In 1995, 1996, and 1997, two RSTs were operated at the site for two months each year as part of the effort to estimate salmon survival as fish moved through the Tuolumne River and through the Sacramento - San Joaquin River Delta. In 1998, a single RST was operated for four months for the purpose of developing salmon production estimates and assessing the timing of the outmigration of different life stages of salmon.
- 2) The duration of RST sampling in 1995, 1996, and 1997 only occurred during a portion of the season when smolts were outmigrating.
- 3) Trap efficiency at the site was very low, i.e., less than 1%.
- 4) Trapping at Shiloh Bridge (river mile 3.4) only occurred in four years. The trap location was changed to Grayson Ranch (river mile 5.2) in 1999.

- 5) Daily catch estimates were expanded in a variety of ways to develop more accurate production estimates. These expansions were also meant to estimate the number of salmon caught on days when the traps did not operate. For example, see pages 7 - 8 of the 1995 - 1996 Shiloh Bridge RST report and page 4 of the RST report providing the 1998 trapping results.
- 6) Several of the captured salmon smolts were tagged with a coded wire tag prior to their recapture at the RST. Queries of the Shiloh Bridge RST database therefore need to be cognizant of this.

BASIC SITE INFORMATION

Watershed: Yuba River.

Trap location: Hallwood Boulevard.

CAMP rotary screw trap number: 22.

River mile at trap location: 6.

UTM NAD83 zone 10 easting: 628509.

UTM NAD83 zone 10 northing: 4337924.

Entity that does the trapping at the trap location: Pacific States Marine Fisheries Commission.

Point of contact: Duane Massa.

Phone number: (530) 570-3474.

Email: duane@psmfc.org.

Chinook salmon runs present in the watershed: fall- and spring-run.

Data for the following years is presented in an annual report: 2000, 2004, 2005.

Year trapping started: 1999.

Normal start of field season: October.

Normal end of field season: June.

Has the sampling always taken place at the same location: yes.

Is a fish hatchery upstream of the rotary screw trap? no.

Reasons why trapping takes place at the trapping location:

Quantify total juvenile salmon production: ✓

Assess relative juvenile salmon abundance:

Monitor juvenile salmon outmigration timing: ✓

Compare environmental factors with juvenile salmon abundance:

Collect juvenile salmon life history data: ✓

SAMPLING GEAR

Number of traps at the trap location: usually 2.

Trap diameter (feet): 5 and 8.

DATA COLLECTION

How is salmon run determined: length at date criteria.

Number of life stages monitored: 5.

Life stages used to classify salmon: yolk sac fry, fry, parr, silvery parr, smolt.

Method used to classify immature salmon according to life stage: morphological features.

Is there an effort to operate traps 7 days/week? yes.

Are traps raised when they are not being serviced? yes.

How many times a day is the trap serviced? at least once.

Daily catches quantified by counting: the number of individual salmon in most instances, and using a water displacement method when large numbers of salmon are present.

Is the salmon length based on a fork or total length? fork.

The length of how many salmon are usually measured each day: 100.

Do listed species affect the trapping operations? yes.

Are trap revolutions monitored and reported? yes.

TRAP EFFICIENCY TESTS

Are trap efficiency tests done at the trap location? yes.

How often are efficiency tests done? 7 - 10 times per year.

Which kind of salmon are used to conduct the efficiency tests? wild salmon.

Are 200+ salmon used for each efficiency test? yes.

Are trap efficiencies pooled across years? no.

The trap efficiency typically is between: 3 - 5%.

Description of trap efficiency tests: the following text is from the 2004 - 2005 Yuba River RST report and is representative of that year and the 2003 - 2004 field season: "In order to obtain a relative measure of trapping efficiency, bi-monthly calibrations were conducted using a sub-sample of no less than 300 Chinook salmon. The sub-sample was marked using a solution of Bismark brown and fresh river water (8 grams Bismark brown per 380 liters of water). The marked salmon were held for 24-hours to insure all marked salmon exhibited normal behavior and to assess any mortality that may have been caused by the staining process. The marked group was then released approximately 0.5 kilometers upstream from the trapping location, and was spread across a cross-section of the river to allow for random dispersement. The number of Chinook salmon recaptured in subsequent sampling was recorded on a daily basis and was used to develop trap efficiencies for differing flow regimes and salmon size classes for each trap. Additional calibration tests were conducted in addition to the bi-monthly tests if the flows or average salmon size was determined to have changed substantially between the normal calibration frequency."

Trap efficiency notes: none.

DATA PROCESSING

How is the number of salmon estimated when the trap does not operate? the missed salmon are not accounted for.

Are half-cone modifications used at the trap location? no.

Are there efforts to highlight periods of bad trap operation? yes.

Is flow/volume used to determine the total number of salmon caught? no.

What confidence intervals are placed on production estimates? none.

Are captures based on partial day operations expanded to 24 hours? no.

Are the formulas used to develop production estimates reported? no.

Are the formulas used to develop variance and confidence intervals reported? not applicable.

Miscellaneous notes:

- 1) A few late fall-run Chinook salmon are present in the Yuba River in some years.
- 2) On some days, a volumetric method is used to estimate the number of fish captured if large numbers of salmon are caught.
- 3) The estimated number of salmon that can be caught in one month can be quite large. In January 2000, it is estimated that 244,562 salmon were caught with one rotary screw trap.
- 4) The presence of listed spring-run Chinook salmon can affect trap operations at the trapping site. For example, trapping activities did not occur between January 15 and January 27 in 2004 because of the large numbers of spring-run Chinook salmon being caught.
- 5) Some of the juvenile salmon at this location are marked with coded wire tags.
- 6) One trap was used during the 1999 - 2000 and 2003 - 2004 field seasons, and two traps were used in the 2004 - 2005 field season.
- 7) Between 2006 and 2007, the RST(s) was operated on a year-round basis.
- 8) Two RSTs are used on the Yuba River in some years. In other years, three traps were used.

- 9) Trap efficiency tests are done on a regular basis in this watershed. The available Yuba River RST reports do not, however, provide total production estimates.

Appendix A: Metadata for the database used to characterize RST operations in the Central Valley

H:\access\RST operations and procedures\master copy of the central valley rotary screw trap database (september 2010).mdb

Monday, August 23, 2010

SourceTable: tbl_basic site info

CAMP_RST_number

Type: Long Integer

Caption: CAMP RST number:

Description: Primary Key. Unique number assigned to each trap location. The numbers in this table provides the basis for assigning RST numbers throughout the database.

Watershed

Type: Text

Caption: Watershed:

Description: Watershed where trapping occurred/occurs.

Trap_location

Type: Text

Caption: Trap location:

Description: Geographic location where a RST was/is operated.

River_mile

Type: Double number

Caption: River mile at trap location:

Description: River mile at the trap location.

UTM_easting

Type: Long integer

Caption: UTM NAD83 zone 10 easting:

Description: UTM easting coordinate for the trap location in a NAD83 zone 10 datum.

UTM_northing

Type: Long integer

Caption: UTM NAD83 zone 10 northing:

Description: UTM northing coordinate for the trap location in a NAD83 zone 10 datum.

Latitude

Type: Long Integer

Description: Latitude of the trap location

Longitude

Type: Long Integer

Description: Longitude of the trap location.

POC

Type: Text

Caption: Point of contact:

Description: Point of contact (POC) who supervised/supervises trapping operations at a particular trap location and was/is responsible for producing reports for that location.

trapping_entity

Type: Text

Caption: Entity that does the trapping at the trap location:

Description: Lookup table. Provides the name of the agency or company that conducted/conducts trapping at a particular trap location.

RowSource: SELECT [LU_tbl_trapping entity].trapping_entity FROM
[LU_tbl_trapping entity]

salmon_runs_in_watershed

Type: Text

Caption: Chinook salmon runs present in the watershed:

Description: Lookup table. Identifies the Chinook salmon runs that was/is caught during RST trapping operations at the trap location.

RowSource: SELECT [LU_tbl_salmon runs].Chinook_salmon_run_present
FROM [LU_tbl_salmon runs]

annual_report_data_years

Type: Text

Caption: Data for the following years is presented in an annual report:

Description: Identifies the years that RST data are presented in an annual report.

#_reports_in_CAMP_files

Type: Long Integer

Caption: Number of reports in CAMP's files:

Description: Identifies the number of annual reports that are in the CAMP files as of March 2010.

year_trapping_started

Type: Long Integer

Caption: Year trapping started:

Description: Identifies the year that trapping operations started at the trap location.

start_field_season

Type: Long Integer

Caption: Normal start of field season:

Description: Lookup table. Identifies the calendar month when trapping operations are normally started each calendar year. In some years, trapping may be initiated in a different month.

RowSource: SELECT LU_tbl_month.order, LU_tbl_month.month FROM LU_tbl_month ORDER BY [order]

end_field_season

Type: Long Integer

Caption: Normal end of field season:

Description: Lookup table. Identifies the calendar month when trapping operations are normally terminated each calendar year. In some years, trapping may be terminated in a different month.

sampling_same_location

Type: Text

Caption: Has the sampling always taken place at the same location:

Description: Provides an assessment of whether the trapping location has remained at the same site since trapping began in the watershed. This field does not account for small changes in the trap location i.e., movements of less than 0.5 miles.

hatchery_present

Type: Text

Caption: Is a fish hatchery upstream of the rotary screw trap?

Description: Is a fish hatchery present upstream of the RST?

quantify_total_juvenile_salmon_production

Caption: quantify total juvenile salmon production:

Description: Is trapping conducted in an effort to quantify total juvenile salmon production?

Format: Yes/No

assess_relative_juvenile_salmon_abundance

Caption: assess relative juvenile salmon abundance:

Description: Is trapping conducted in an effort to assess relative juvenile salmon abundance?

Format: Yes/No

monitor_juvenile_salmon_outmigration_timing

Caption: monitor juvenile salmon outmigration timing:

Description: Is trapping conducted in an effort to monitor juvenile salmon \ outmigration timing?

Format: Yes/No

compare_environmental_factors_with_juvenile_salmon

Caption: compare environmental factors with juvenile salmon abundance:

Description: Is trapping conducted in an effort to compare environmental factors with juvenile salmon abundance?

Format: Yes/No

collect_juvenile_salmon_life_history_data

Caption: collect juvenile salmon life history data:

Description: Is trapping conducted in an effort to collect juvenile salmon life history data?

Format: Yes/No

phone_number

Type: Text

Description: Telephone number of the point of contact.

email

Type: Text

Description: Email address of the point of contact.

Table: tbl_data collection

CAMP_RST_number

Type: Long Integer

Caption: CAMP RST number:

Description: Primary Key. Unique number assigned to each trap location. The numbers in this table provides the basis for assigning RST numbers throughout the database.

salmon_run_determination

Type: Text

Caption: How is salmon run determined:

Description: Lookup. Identifies the runs of Chinook salmon that could be caught by a RST at a trap location.

RowSource: SELECT [LU_tbl_how is the run determined?].run_determined_by
FROM [LU_tbl_how is the run determined?]

#_life_stages_monitored

Type: Long Integer

Caption: Number of life stages monitored:

Description: Quantifies the number of life stages that are assigned by the biologists that operate a RST at a trap location.

life_stages_to_classify_fish

Type: Text

Caption: Life stages that are used to classify salmon:

Description: Lookup. Identifies the suite of life stages that are used to classify juvenile Chinook salmon at a trap location.

RowSource: SELECT [LU-tbl_life stages used to classify

method_to_classify_life_stage

Type: Memo

Caption: Method used to classify immature fish according to life stage:

Description: Identifies the characteristics used to classify juvenile salmon according to a life stage at a trap location.

effort_to_fish_traps_7_days/wk

Type: Text

Caption: Is there an effort to operate traps 7 days/week?

Description: Field providing an indication of whether the RST(s) at a trap location are operated 7 days each week.

traps_raised?

Type: Text

Caption: Are traps raised when they are not being serviced?

Description: Field assessing whether trap cones are raised at a trap location and are therefore unable to catch fish on days when biologists are not available to collect fish from a RST live box.

times_day_trap_serviced

Type: Text

Caption: How many times a day is the trap serviced?

Description: Indication of how many times a day biologists usually service a RST at a trap location and recover captured fish.

catches_quantified_by

Type: Text

Caption: Daily catches quantified by counting:

Description: Method used to quantify the number of fish that were collected since the trap was last serviced at a trap location.

fork_or_total_length

Type: Text

Caption: Is the fish length based on a fork or total length?

Description: For the fish that have their length measured at a trap location, indication of whether fork length or total length is used as length is determined.

#_fish_for_daily_length

Type: Long Integer

Caption: The length of how many fish are usually measured each day:

Description: Number of fish that biologists would typically measure each day at a trap location to assess length frequency.

fish_only_counted_1_time

Type: Text

Caption: Are captured fish only counted 1 time in the production estimate

Description: Indication if, for those sites where trap efficiency tests are conducted, whether a fish is only counted one time toward a production estimate, or whether a recaptured fish could be counted twice.

listed_species_affect_trapping

Type: Text

Caption: Do listed species affect the trapping operations?

Description: Indication of whether trap operations at a trap site are altered or hindered due to the need to minimize the take of listed fish species.

trap_revolutions_monitored

Type: Text

Caption: Are trap revolutions monitored and reported?

Description: Indication of whether trap revolutions each day at a trap location are counted and recorded.

Table: tbl_data processing

CAMP_RST_number

Type: Long Integer

Caption: CAMP RST number

Description: Primary Key. Unique number assigned to each trap location. The numbers in this table provides the basis for assigning RST numbers throughout the database.

estimating_#_missing_fish

Type: Text

Caption: How is the number of fish estimated when the trap does not operate?

Description: Lookup. Indication of how the number of untrapped fish at a trap location may be estimated on days when the trap did not operate.

RowSource: LU-tbl_estimate missed fish

half-cones used

Type: Text

Caption: Are half-cone modifications used at the trap location?

Description: Indication of whether one half of the RST trap cone was/is blocked during trapping activities, with the goal of reducing the capture of listed species of Chinook salmon.

highlight_periods_bad_trap_ops

Type: Text

Caption: Are there efforts to highlight periods of bad trap operation?

Description: Indication of whether the POC at a trap location collects operational data (high debris load, low trap RPMs, etc.). These data could be used to determine how well a RST performed on a given day.

bad_trap_data_used

Type: Text

Caption: Are data during bad trap operations not used in production #s?

Description: Indication if days with less than perfect data (e.g., a trap only functioned 1/2 of a day) are used to estimate a daily catch total or production estimate.

flow/volume_used

Type: Text

Caption: Is flow/volume used to determine the total number of fish caught?

Description: Indication of whether stream discharge was/is used to estimate salmon production.

confidence_intervals_used

Type: Text

Caption: What confidence intervals are placed on production estimates?

Description: Quantative value identifying the confidence intervals placed on production estimates in the annual RST reports.

RowSource: SELECT [LU_tbl_confidence intervals].confidence_intervals_used
FROM [LU_tbl_confidence intervals]

bootstrap_confidence_intervals

Type: Text

Caption: Are confidence intervals based on boot straps?

Description: Indication of whether or not boot straps (i.e., Monte Carlo simulations) are used to estimate confidence intervals on production estimates.

partial_day_operations_expanded

Type: Text

Caption: Are captures based on partial day operations expanded to 24 hours?

Description: Indication of whether the data collected on a day when the trap did not operate 24 hours was expanded to provide a 24-hour extrapolation.

formulas_for_production_estimates_reported

Type: Text

Caption: Are the formulas used to develop production estimates reported?

Description: Indication of whether the formulas used to develop production estimates are provided in a RST annual report.

formulas_for_variance_CIs_reported

Type: Text

Caption: Are the formulas used to develop variance and CIs reported?

Description: Indication of whether the formulas used to develop confidence intervals on the production estimates are provided in a RST annual report.

Miscellaneous_notes

Type: Memo

Caption: Miscellaneous notes

Description: Miscellaneous notes related to data processing or data capture.

Table: tbl_sampling gear

CAMP_RST_number

Type: Long Integer

Caption: CAMP RST number:

Description: Primary Key. Unique number assigned to each trap location. The numbers in this table provides the basis for assigning RST numbers throughout the database.

Number_traps_at_trap_site

Type: Long Integer

Caption: Number of traps at the trap location:

Description: Indication of the number of RSTs that are deployed in most, if not all years of operation at a trap location. On occasional, more or less traps could be deployed at the trap location.

RowSource: SELECT LU_number_of_traps_used.ID,
LU_number_of_traps_used.number_of_traps_used FROM

Trap_diameter

Type: Text

Caption: Trap diameter (feet):

Description: Lookup. Quantifies the diameter of the RST cone that is usually deployed at a trap location. In feet.

RowSource: SELECT [LU_tbl_trap diameter].trap_diameter FROM
[LU_tbl_trap
diameter]

Table: tbl_trap efficiency tests

CAMP_RST_number

Type: Long Integer

Caption: CAMP RST number:

Description: Primary Key. Unique number assigned to each trap location. The numbers in this table provides the basis for assigning RST numbers throughout the database.

E_tests_at_location?

Type: Text

Caption: Are trap efficiency tests done at the trap location?

Description: Indication of whether or not trap efficiency tests were/are done at a trap location.

How_often_E_tests_done

Type: Text

Caption: How often are efficiency tests done?

Description: Indication of how frequently, in general, trap efficiency tests were/are done at a trap location.

kind_of E_fish?

Type: Text

Caption: Which kind of fish are used to conduct the efficiency tests?

Description: Indication of whether wild, hatchery-origin, or a combination of these 2 types of fish were/are used to conduct trap efficiency tests.

200+_fish_for_E_test?

Type: Text

Caption: Are 200+ fish used for each efficiency test?

Description: Indication of whether a minimum of 200 fish are usually used to conduct trap efficiency tests at a trap location.

E_efficiencies_pooled_across_years?

Type: Text

Caption: Are trap efficiencies pooled across years?

Description: Indication of whether biologists for a trap location pool trap efficiency data across multiple years in an effort to build a trap efficiency model

E_test_typically_is_between

Type: Text

Caption: The trap efficiency typically is between:

Description: Lookup. General indication of what RST trap efficiencies at a trap location typically were/are. Numbers greater than or less than those presented are possible.

RowSource: SELECT [LU-tbl_typical trap efficiency].typical_trap_efficiency
FROM [LU-tbl_typical trap efficiency]

E_test_description

Type: Memo

Caption: Description of trap efficiency tests:

Description: General description of how trap efficiency tests were/are done at a trap location.

trap_E_notes

Type: Memo

Caption: Trap efficiency notes:

Description: Miscellaneous notes describing how trap efficiency tests were/are done at a trap location.

